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Caitlin Waite
Portland State University

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A Publisher's Look at eBooks and Their Affect on Young Readers

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Research question: "What is the effect of reading on screen versus reading in print for a child's comprehension of the material he/she has read? Does this effect differ with different ages, or with standard ebooks versus interactive ebooks? What can publishers do to minimize any negative effects?"

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As publishers it is important to learn about new reading platforms and how to use them to the benefit of readers. There have been numerous advancements in the past several years with regard to electronic books (or eBooks), including an emergence of technology that allows for relatively easy and cost effective ways to create eBooks for children. As eBook technology advances, questions are arising about the eBook's validity as a learning tool, and whether it is even safe for children to be using eBooks at all. Studies have been conducted in the recent past with the goal of answering these questions, and despite inconclusive results, many parents have decided against using eBooks entirely. The findings of several studies show eBooks may have great benefits for children learning to read, including options for differently abled readers, narration and word help for younger readers, and interactive choices for readers who are a bit more reluctant. To research the validity of the eBook as a learning tool, this paper will examine the brain's capacity for reading, the differences between reading on paper and on screen, and how these differences affect young readers. Next it will discuss how different age groups interact with reading technology and the effects basic eBooks and interactive eBooks have on the reader. Finally it

will explore what publishers —and parents— can do to combat any ill effects and create a positive reading experience for children.

Harmful Physical Effects of eBooks

A 2015 sleep study shows that reading from a light-emitting (LE) device before bed affects sleep, making a person less tired when they go to bed and less awake the next day. It has been known for several years that the LCD screens on some eReaders cause eyestrain, but this is the first study showing the exact effects they can have on sleep. The reason that reading from an LE eBook negatively affects sleep patterns is that the blue light shining in a reader's face causes lowered melatonin levels, the hormone that the body produces in the evening to cause drowsiness. It has a cascading affect on a person's sleep pattern:

“Firstly, light from the screens will increase alertness at the very time you should be winding down, which can delay people's bed-times. This exposure will then prolong the length of time it takes to fall asleep, which delays the circadian rhythm, which reduces the amount of melatonin that the body produces. It can also delay and reduce the amount of REM sleep, and finally it will negatively impact awareness the following morning... and cause the onset of higher melatonin levels to be delayed the following day by around 1.5 hours” (Chang 1).

Alternatives to reading on LE eReaders before bed include paper books and products without a backlit screen, like e-ink readers. If these are not possibilities, there are applications that help combat the blue light emitted from screens, reducing the amount as it gets later in the day.

The Different Brain Processes of Reading

If all negative effects from the screen itself are eliminated, all that is left is the content of the eBook and the way in which it is displayed and absorbed by the reader. To fully understand how eBooks may change the way a reader comprehends a story, it is necessary to learn how the brain completes the task of reading paper material. As Maryanne Wolf of Tufts University explains in her book *Proust and the Squid*, humans are not born with brain circuits dedicated to reading. The brain improvises a circuit by using regions of neural tissue used for speech, vision, and motor coordination. Some of these regions are used for object recognition, which is how people perceive the letters—as objects—and how a person may perceive the whole text as a kind of physical landscape. Wolf explains that this may be why people dislike reading from a screen, or find it more difficult to get through a text. The visual landscape that the brain is used to, right and left page, eight corners, upper and lower sections, is changed when reading an eBook, and this can cause a reader to get “lost” while trying to navigate unfamiliar terrain. Readers are also only getting visual stimuli as opposed

to the tactile information created from holding a book and knowing where exactly one is in the text. Abigail Sellen, of Microsoft Research Cambridge, states that, “The implicit feel of where you are in a physical book turns out to be more important than we realized.” Not knowing where one is physically in an eBook is a problem for some readers and may be what causes the brain to have trouble comprehending the story as well it does when reading in print (Jabr 1). Studies looking into this aspect of eBook reading have yet to yield any conclusive results. Some show slightly lower comprehension-test scores for students who read on screen rather than paper, while some show no difference. In a study conducted at Sweden’s Karlstad University by researcher Erik Wästlund, students performed equally well in comprehension tests, but less well on memory exams. This led to the conclusion that scrolling is more mentally draining than turning a page because a reader must focus on both the text and how it is moving. That mental exhaustion causes the lower memory scores (Wästlund 23).

Our brain performs the basic function of reading on paper through various brain circuits. Beyond the basic function, however, there is “deep reading,” which is the feeling a person gets when they are completely absorbed in a text—all focus on the page as they move through the page. When reading from a print book the brain performs what is called “linear reading.” That is, moving straight across (or up and down as the case may

be) the page, line by line, as one reads. Linear reading is the type of reading that is believed to lead to deep reading, because we are able to focus completely on the text. According to Manoush Zomorodi, host of *Tech City*, when reading from a screen the reading process changes. Because our main interaction with screen reading comes from internet pages, our brains have been trained into what is called “non-linear reading.” This is described as our eyes darting around the page as they browse and scan for important information on the screen, rather than reading a text straight through (Zomorodi 1). This makes it harder to focus entirely on the text, and therefore, it makes it harder to enter a state of deep reading. This “deep reading” state is what some researchers believe to be the key to comprehending and remembering a story, so the lack of this ability when reading non linearly may be why some test subjects perform more poorly when reading from a screen.

Children’s Comprehension and eBooks

Marianne Wolf asks, “Will the present generation become so accustomed to immediate access to on-screen information that the range of attentional, inferential, and reflective capacities in the present reading brain will become less developed?” It is an interesting question to consider, and researchers will have to wait a few years until these young readers grow up to find out fully. Looking at the studies available

currently, young children seem to be having a much less difficult time reading on screen than their advanced-reader counterparts. If a child has grown up reading from a screen (i.e. practicing non-linear reading), his or her brain may not need to process information in the same way as someone who has grown up reading linearly from paper (Guernsey 1). Recent studies have shown that the level of comprehension achieved with eBook reading seems to be based mainly on the amount of interaction with technology. The Nielsen Norman Group – a computer user interface research firm – conducted two studies, eight years apart, and the results of the most recent show that younger children are much more comfortable with the technology than the last time they ran the study, so much so that they were prompted to bring in a 3–5 year old age group, which they did not have in the original. Contrary to the Wästlund study, which posited that the need to scroll through information was what caused the test subjects to perform poorly on memory tests, the Nielsen study shows that children age nine and up, having had several years of experience on the web, are comfortable with scrolling. Actually, they prefer scrolling as opposed to having several pages of text to click through while they read. The children did equally as well on comprehension questions whether they read from web pages or printed ones (Nielsen 1). Clearly, these children are used to reading

from web pages; their brains are comfortable reading non-linear text. The study also shows, however, that while the children are comfortable with scrolling they do focus more on text at the top of the page than the text lower down, and just like their adult counterparts in the study, the children are less willing to read what they consider non-essential text, like instructions.

Not only are children becoming comfortable with on screen reading, but recently, other studies have shown benefits that eBooks are bringing to groups less likely to be reading at the expected level. Several studies show eBook technology may be closing the “gender gap” (a description of the comparatively poor performance of boys in traditional reading assessments) that exists now, as well as the gap in reading level between socioeconomic backgrounds. The Programme for International Student Assessment (PISA) showed in 2009 that although the gender gap was still present, it was narrower for digital reading (Fleischman 27). The National Literacy Trust had similar findings in 2012, stating that boys were significantly more likely to read on screen than in print outside of school. The socioeconomic gap narrowed in this study as well when moving from print reading to on screen reading. Students who were eligible for free school meals were much more likely to read on screen than in print outside of school (Picton 5).

Standard eBook Vs. Interactive eBook

Children are more comfortable reading from a screen than in the past, and there are some benefits for less likely readers, but are the children learning as much as they would with a print book? Many of the above studies have had mixed findings about this question, and many do not include enhanced/interactive eBooks in their study. Does it make a difference in comprehension level if a child is reading from an interactive eBook as opposed to a basic eBook? To answer this question properly, the difference between basic and interactive/enhanced eBooks must be defined. A basic eBook may contain text elements, static graphics, and limited interactivity including page flipping or the ability to change the font or look up a word. An interactive eBook can be much more versatile, containing audio and video elements, interactive graphics, even games built in to the story.

Knowing these definitions, the question at hand can be more easily answered. Does it make a difference in comprehension level if a child is reading from an interactive eBook as opposed to a basic eBook? The short answer? Yes. Interactive eBooks have more distracting elements on the page. This is not taking into account the level of distraction if the eReader has internet capabilities, which may lead to distraction in either case. In a study done with children ages 3–6 (and a parent) by the Joan Ganz Cooney Center – an “independent research and innovation lab that focuses on

educating children in a rapidly changing media landscape”—it was shown that when it came to recalling narrative details of a story, the enhanced eBook caused both the child and the parent to focus on non-content rather than story-related issues, which led to less retention of narrative details. In terms of explaining a critical element of the story, however, children performed almost equally whether they were reading from a print book, standard eBook, or interactive eBook. Basically, the reading experience is going to be different if dealing with only text and basic pictures as opposed to animation or multi-media aspects. As long as the extra elements can enhance rather than detract, or distract, from the story, then an interactive eBook can be just as good for reading than a standard eBook. Examples of how to make extra elements beneficial will be explored later. In some cases—such as with very young children or reluctant readers—an enhanced eBook may even be a better choice than paper (Chiong 2).

A 2014 study in Switzerland explores how best to use interactive eBooks to support leisure reading. They discuss intrinsic motivation versus extrinsic, questioning whether it is better to make an eBook more like a game (creating an extrinsic value to the reading part) or a playful book (keeping the core focus of the book on the textual component). First though, they lay out some definitions of intrinsic and extrinsic motivation. Intrinsic would be to read for one’s own sake, not

having any external factors making one read, like school. When reading for extrinsic reasons, a person is reading for a purpose. Making an eBook more like a serious game (games developed with the intention to be more than mere entertainment) could cause children who see no intrinsic value to reading to now have an extrinsic motivation to engage. Their intrinsic motivation is to play the game, but this acts as extrinsic motivation for the reading portion. The issue with this is that studies have shown that extrinsic motivations can hurt the intrinsic value. The child comes to need the outside motivation to read rather than reading for the sake of reading. For this reason, Colombo and Landoni advocate “playful books” over “serious games,” keeping the focus on the text while adding a portion of interactive and multimedia elements (Colombo 3).

Publishing Options For Minimizing Negative eBook Effects

A look at what this paper has shown so far: Reading on screen means non-linear reading. Young children are very capable of non-linear reading, and most prefer it to linear. Enhanced eBooks can be distracting, but can also be a great way to get children involved in the text. What can publishers do with all of this information to make the best books possible while stimulating learning and encouraging children to read?

ePub Options

- Different ePub applications have different features available to work with. As a publisher it is important to know what technology exists so that it can be taken advantage of when making a book. Below is a graph that highlights the differences in various ePub software available today. Keep in mind the limitations of technology when planning an eBook (Architects 1).

	Apple	Amazon	B&N	Kobo	Google
Format	ePub2/ePub3	KF8	NOOK Kids	ePub2/ePub3	ePub2/ePub3
Narration	✓	✗	✓	✓	✓
Narration Text Highlighting	✓	✗	✗	✓	✓
Region/Text Magnification	✗	✓	✓	✗	✗
Embedded Audio/Video	✓	✗*	✗	✓	✓
Background Music	✓	✗	✗	✗	✗
Animations	✓	✗	✗	✓	✗
Interactive Elements	✓	✗	✗	✓	✗

Interactivity

- Make options for the level of interactivity. Very young readers may rely heavily on the interactive options as they are learning words and sounds. For a slightly older child the interactivity can be turned off so that they aren't distracted. Allow the parent to choose from the outset what they are trying to accomplish with this book; is

this strictly a learning experience or playtime as well?

- Make sure animations or interactive options add to the story. There are many options for interactivity that enhances the text, such as the “mise-en-scene” approach, which allows the reader to set the stage for each scene they read. The reader can move characters into position or adjust their facial expressions, set the scene by moving around objects etc. and even change the look of the story by choosing their favorite character. As a side note, steer clear of “static graphics.” Not everything on the page has to trigger something, but if an object is made to look like it should respond to a touch, make sure that it does. Children are very quick to disengage if they are frustrated, and a misleading graphic can be both frustrating and disappointing (Al Aamri 3).

- Less is more. Interactive and multi-media options in an eBook can be made to enhance the story, but even these elements can get to be too much. In a study by Ofra Korat it is shown that the more interactive “hot spots” on a page, the less the reader is able to follow the story line (Korat 2).

Layout

- Think outside the page. The Nielsen Norman Group study showed us that as kids get introduced to technology at a younger age,

they are becoming more comfortable earlier with reading text they have to scroll through. Rather than straining to make an eBook into the same format as a paper book, get creative. The text could be in a scrollable infographic, or could allow the reader to pick which direction to move in to progress the story.

- Make considerations for those who read differently. Having narration along with text can help the visually impaired to enjoy the story. For children with dyslexia and other reading disorders eBooks can be a great option. The one page view allows them to focus on the small piece of text in front of them, rather than being overwhelmed with the visual of so many pages. There have also been advances recently in fonts that allow people with dyslexia to more easily distinguish between letters, which is something that could be implemented in print and eBooks (Schiavo 3).

- Here is a sample of **Dyslexie**, a font created to make reading easier for people with dyslexia. The letters have the same basic shape as any font, but by making the letters heavier or lighter in strategic places, letters like “d” and “b” are distinguishable even if turned around (Hohenadel 1).

Other Considerations

- Target very narrow age groups. Even one year can make a significant difference not only in cognition, but also in text navigation skills and technological abilities. Children are also very aware of age differences and will be turned off to a book if it is even slightly below or above their age group (Nielsen 3).

- Think of the children. According to a 2014 Scholastic Reading Report, the main things that children are looking for in a book are that it makes them laugh and lets them use their imagination. This was echoed across all age ranges (Scholastic 1). According to that study, 91% of children 6-17 surveyed say that their favorite books are ones they have chosen themselves (Scholastic 2). Children want to have options; they want to be an active part of their reading experience. If publishers can create eBooks that give readers more choices while reading, they can excite and involve children in such a way that they will want to continue reading as they grow. The motivation study in Switzerland came to the conclusion from their questions that the three aspects of intrinsic motivation for children to read are curiosity, desire for challenge, and involvement (Colombo 4).

- Get parents involved. According to the Scholastic report cited above, children want to be actively involved in their own reading

experience, but they want their parents to be involved too. This report tells us is that “when it comes to being read aloud to at home, more than eight in 10 children (83%) across age groups say they love(d) or like(d) it a lot—the main reason being it was a special time with parents” (Scholastic 2). Not only do children enjoy reading with their parents best of all, doing so can help them to be excited about learning and more actively involved in their own education. This is just as true for electronic media as print, and is known as “Joint Media Engagement”, a term coined by learning scientists at the LIFE Center (Chiong 2). So eBooks that promote parent and children engaging together can help spark these shared learning moments and cause the children to see reading (and learning) as positive and fun as they get older.

Conclusion

While reading on an eReader does cause the brain to work differently than when reading from paper, this is not inherently a bad thing. The upcoming years will show if the non-linear reading options technology provides lead to children losing the ability to deep read, as some researchers fear, or if our brains will adapt to this new way of getting information, as they did when reading itself first came about. There are many options to ensure that a child gets the optimal reading experience on an eReader, and these

options will grow and change along with technology. In reality though, the most important parts of the reading and learning experience have little to do with the platform. If publishers can create an experience in which both the child and parent are actively involved and excited about reading, this creates an optimal learning experience in spite of all other factors.

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