Designing for On-Screen Narrative Reading: Investigating Text Structure and Reading Comprehension

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Abstract

When it comes to supporting the in-depth linear reading strategies required to process long, information-rich texts, on-screen reading interface designs continue to fall short. With a majority of readers’ long-form reading preferences defaulting to printed texts, there is a need to investigate how and why texts presented on screen are failing readers. In the current study and design of on-screen texts, both scholars and designers fail to account for a text’s conventional structure (from its grammatical construction, to the graphic organization of its content), and how this structure affects the reader’s ability to process the text’s content. For texts with a well-known conventional structure, such as narrative texts which conform to both semantic and spatial structural conventions, text structure cannot be divorced from the cognitive processes of reading and comprehension. Drawing from the fields of narratology, cognitive psychology, and human computer interaction this paper investigates how the study and design of on-screen narrative texts can be improved by understanding and maintaining conventional narrative structures.

Keywords
discourse comprehension, narratology, on-screen reading, text structure, comprehension

Continued criticism of digital reading suggests that reading behaviour on screen differs significantly from reading behaviour supported by printed text. Indeed, studies have found that with on-screen reading comes increased use of non-linear reading strategies such as skimming and scanning, along with a corresponding decrease in in-depth, concentrated reading (Liu, 2005). These selective reading strategies, such as scanning and keyword searching, are seen as coping methods for the information overload that characterizes our current age (Liu, 2005). In studying digital reading, however, there is the need to differentiate between instances of cursory reading that make up our everyday interactions with both print and online content and in-depth, sustained linear reading that is characterized by reading longer, information-rich texts (Cull, 2011).

Narrative Texts: Deep Attention and Comprehension

Narrative reading falls under the category of long, information-rich texts, and requires very different kinds of reading strategies – specifically those associated with deep attention. Deep attention, which is defined by
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Katherine Hayles (2007) as a sustained, concentrated, and engaged reading behaviour, is what is needed in order to successfully comprehend narrative texts. This paper looks specifically at comprehension as the outcome measure for a successful reading experience, as this is a common measure analyzed in studies of both on and off screen reading.

When considering narrative texts, this paper focuses on a conventional narrative, one that has a defined episodic structure (Kintsch, 1997) and is made up of what Ryan (2004) has defined as “an interpretive network of goals, plans, causal relations, and psychological motivations” around a set of “narrated events” which make up a plot (p. 8-9). And so, unlike expository or other information rich text-types, a narrative text requires sustained, engaged, linear reading in order to comprehend and interpret the narrative as it unfolds. As a point of reference, a fairy tale is a good example of a traditionally structured narrative.

Cognition and Reading: Mental Models and Cognitive Load

Looking at the cognitive psychology behind narrative reading, digital text design that supports deep attention and comprehension needs to take into account two key cognitive concepts: mental models, and cognitive load. Related to reading, mental models are a reader’s basic understanding of a text’s structure and construction, which provide “predictive and explanatory power” that helps the reader interact with the text (Norman, 1983, p. 7). A mental model for reading is based on a reader’s knowledge of the text-types conventional form, which is both spatial (the way the text is laid out and organized) and the semantic structure (the linguistic organization of the text) (Dillon, 2004). Essentially, a mental model helps a reader effectively navigate through and comprehend a text (Zumbach & Mohraz, 2008; Dillon, 2004; Pearson, Buchanan & Thimbleby, 2014; van Dijk & Kitsch, 1983). While mental models aid in a reader’s ability to navigate and understand a given text, the associated level of cognitive load the reader experiences can detract from comprehension and understanding. Cognitive load refers to the amount of mental effort it takes to process a given text (DeStefano & LeFevre, 2007). An increase in cognitive load results in fewer mental resources to engage in the deep reading process, and therefore lowers reader comprehension (Zumbach & Mohraz, 2008). Textual features that can increase a reader’s cognitive load are unexpected structural, semantic and linguistic characteristics (Dillon, 2004; Kintsch, 1976; Pearson, Buchanan & Thimbleby, 2014). Studies of on-screen reading have demonstrated that in general, the mental effort required to read digital texts is higher than for print texts (Pearson, Buchanan & Thimbleby, 2014).

The Book Metaphor and On-Screen Text Design

One way to approach text design online, specifically as it relates to mental models and cognitive load, is by investigating the use of the book metaphor. The book metaphor is defined as a “way of visualizing and interacting with digital text using typically physical techniques” drawn from printed texts, such as maintaining page units and text linearity (Pearson, Buchanan & Thimbleby, 2014, p. 22). A debate currently exists between those who believe that maintaining the book metaphor makes for successful on-screen book design, and those who, acknowledging the new affordances of digital technology, argue that designers of digital texts must experiment with new features and formats in order to best utilize the digital medium (Siemens & Koolen, 2013; Pearson, Buchanan & Thimbleby, 2014; Dillon, 2004; Pressman, 2014).

Applying the concepts of mental models and cognitive load to the design of on-screen narrative texts can help differentiate between on-screen textual representations that may support deep reading and narrative comprehension, and those that may hinder them. And this here where the debate over the book metaphor gets introduced: those who criticize the book metaphor argue that employing it in digital text design means using new technologies to recreate a previously imperfect system of reading, which also means ignoring the innovative functionalities of digital technology (Siemens & Koolen, 2013; Pearson, Buchanan & Thimbleby, 2014; Pressman, 2014). Though tenable in their desires for innovation, those who fear that recreating printed text affordances on a screen will limit the potential of new technologies rarely account for the cognitive aspects of reading, particularly cognitive load and the utilization of user’s existing mental models. Claims that designers “should be focusing less on
mimicking the look and feel of the book and page and rather, be concerned with modelling the function and use [of the book]” (Siemens & Koolen, 2013, p. 111) fail to acknowledge that the “look and feel” of a book are inextricably tied to its function and use, and affect the reader’s ability to interact productively with the text.

Emerging on-screen constructions of narrative texts, such as hypertext narratives, provide a perfect example of how disposing of the book metaphor can produce texts that are both difficult to navigate and comprehend. Because these texts don’t conform to the conventional structure of narratives and reader’s mental model for narrative reading they result in higher cognitive load for the reader and lowered levels of reader comprehension (Miall & Dobson, 2006; Mangen 2008; DeStefano & LeFevre, 2007). Some of the factors that create these unwanted reading results are hypertextual narrative’s unclear structure and navigation, both of which work to “[discourage] the absorbed and reflective mode that characterizes literary reading” (Miall & Dobson, 2006, abstract).

Working in opposition to hypertext narrative designers, proponents of implementing the book metaphor acknowledge the importance of maintaining the “look” and layout of a text for reader comprehension. Maintaining the spatial and semantic structural components of printed texts on-screen allows readers to apply the mental models acquired in print reading to on-screen reading. In a study on the usefulness of the book metaphor, Landoni and Gibb (2000) found that by structuring on-screen texts like their print counterparts, readers did not have to update their mental models for on-screen reading. By providing readers with a text structure consistent with their pre-existing mental models, the level of cognitive load experienced by the reader in processing textual content is lowered (Pearson, Buchanan & Thimbleby, 2014; Landoni & Gibb, 2000; Dillon, 2004).

Though spatial and semantic structural components are necessary to aid in reader comprehension, the new processes of on-screen navigation are necessarily distinct from those used to navigate print texts and can add to a reader’s cognitive load. In combination with maintaining text structure, on-screen navigation controls must be strategically implemented to support effective navigation that allows the reader to move through the text without becoming distracted or disoriented (Pearson, Buchanan & Thimbleby, 2014). Because of their long, linear format, on-screen narrative texts are seen as “accentuating the issue of navigation” affecting readers of digital texts (Mangen, 2013). Navigation then, in addition to text structure, is an important consideration in the effective design of digital narrative texts. Through effective structural and navigational design, readers will be able to focus their attention on text processing, instead of being distracted by unfamiliar and cognitively demanding interface implementations.

**Understanding Semantic and Spatial Text Structure in Print and On-Screen**

Semantic text structure is studied specifically under the cognitive psychology rubric of discourse comprehension. Discourse comprehension outlines how readers comprehend textual meaning by interpreting semantic cues and constructing mental representations of the text. While discourse comprehension can be studied at various levels of complexity, such as word, clause, sentence, and overall textual structure (van Dijk & Kintsch, 1983), for the purposes of designing for narrative texts on screen, the most useful level to consider is that of overall textual structure.

For van Dijk & Kintsch (1983) most discourse types possess a “conventional, and hence, culturally viable, schematic structure” (p. 16), which they label the superstructure. At the highest level of processing, a superstructure “provides the overall syntax” for a text’s “global meaning” (van Dijk & Kintsch, 1983, p. 16) and therefore aids the reader in top-down discourse processing. The superstructure of a text is made up of textual elements such as prefaces, introductions, headings and paragraphs and varies from one text-type to another (van Dijk & Kintsch, 1983). Acknowledging these textual cues as a reader enables smoother linguistic comprehension of the text. Empirical evidence has demonstrated that when a discourse type’s superstructure is intact, readers are able to build “better representation[s] in episodic memory” (van Dijk & Kintsch, 1983, p. 241) and are better able to comprehend the text as a whole.

Spatial elements of text structure also play an important role in the processing and comprehension of a text. At a granular level, reading can be considered a spatial activity where the reader’s eyes move across text on a page (Fischer, 2000). Empirical studies have demonstrated that readers retain and then
use the spatial elements of text, such as layout and information location (Fischer, 2000) for better recall and comprehension of textual content (Fischer, 2000; Dillon, 2004; Li, Chen & Yang, 2012). The use of text-type conventions for “layout and structure is a major precondition” for the comprehension of texts on screen (Lemken, 1999, p. 3). Spatial cues then are essential to a reader’s ability to apply an existing mental model to a text, allowing the reader to process textual content by reinforcing knowledge of the “physical structure and meaningful content” for a specific text-type (Payne & Reader, 2006). So, just as semantic cues provide orienting information for readers, text-type layout conventions can also be used to orient readers unconsciously and aid them in text processing and retrieval.

Taken together, the unique semantic and spatial elements of a conventional text-type structure become an extremely valuable tool for reading comprehension. Simplifying the distinction between semantic and spatial text structure, Dillon (2004) incorporates both textual elements in what he defines as “text shape” (p. 126). Text shape acknowledges that readers, in addition to “identifying placement and layout […] directly recognize and respond to content and meaning of a text” (Dillon, 2004, p. 126). Semantic and spatial cues can also occupy the same textual element. For instance, a paratextual semantic cue, such as a “Prologue” heading, provides the reader with expectations of the content to come, while also aiding the reader in understanding the spatial organization of the text, such as the order and location of specific content (van Dijk & Kintsch, 1983; Li, Chen & Yang, 2012). For Dillon (2004), violations of conventional text shape detract from the usability of a text in multiple ways: “This detraction might induce a time cost (less efficiency), an output cost (less effectiveness), or an affective cost (lower satisfaction)” (p.131). These usability detractions are amplified when moving texts on screen, given that the digital reading interface is less familiar to readers than a printed text.

The narrative text-type is one of the most well understood forms of discourse in cognitive psychology and discourse comprehension (Kintsch, 1977), making both its semantic and spatial structures well known. For example, some defining characteristics of narrative texts are the following: a superstructure composed of conventional categories such as setting, complication and resolution; content that is delivered in distinct narrative units; content is structured using an “uncontroversial notational or formal system (numbers, headers, titles, or paragraph breaks)” that is easily understood by readers (Meister, 2010, n.p.). Other common structural cues include linearity, length, and paratextual materials such as a table of contents or an epilogue.

Despite the general acceptance of these semantic and spatial structural characteristic conventions, when it comes to designing on-screen narrative texts, their effect on reader comprehension is rarely considered.

**Designing for Narrative Texts On-Screen**

It has been repeatedly proven that “comprehension and learning may be facilitated as long as readers are able to understand the organizational structure of the representation of the text environment and use this structure to effectively control navigation” (Sullivan & Puntamkebar, 2015, p. 300). So, in conceiving potential design characteristics for on-screen narrative texts that are easily processed and comprehended by the reader, two key considerations must be addressed: first, maintaining the conventional structural and semantic features of narrative texts and second, implementing complementary navigation controls that are intuitive to the reader and help a reader understand their place in the text.

**Implementing Text Shape**

There is very little consistency in on-screen narrative text design, a characteristic that needs to change in order to improve reader comprehension (Dillon, 2004). First, careful attention should be given to maintaining narrative texts’ semantic content, including headings and any other organizational features such as tables of contents, prologues and epigraphs. In addition, care should be taken to maintain the overall organization of the text, including paragraph, section and chapter breaks. Retaining pagination, or at least fixed page units, is also essential for reader comprehension.

**Implementing Text Shape Compatible Navigation**
Complementary navigational controls are necessary to implement successful on-screen narrative texts. Even if conventional text structure is maintained on screen, this structure may not be interpreted effectively if navigation control design is not well executed (Mangen, Walgermo & Brønnick, 2013). Two key design characteristics for on-screen narrative text navigation are maintaining page-by-page navigation and including visual cues for locating one's place in the text. Page-by-page navigation facilitates the construction and implementation of relevant mental models, in addition to better comprehension and text recall (Piolat, Roussey & Thunin, 1997). Similarly, visual location cues (such as a progress bar showing the reader their movement through the text), help the reader to gain a global perspective of the text as a whole (Lemken, 1999), which allows the reader to better understand the text's overall organization and structure, which in turn improves comprehension (Mangen & Kuiken, 2014).

Looking Forward – Studying and Designing for Text Shape On-Screen

Understanding the importance of text shape in digital text design highlights the need for scholarly and industry attention to be placed on texts’ semantic and spatial structures in both the study and design of on-screen texts and digital reading interfaces. It is easily recognized that industry digital text design standards are lacking, and that the cacophony of current design implementations is only hindering reading comprehension further by increasing the cognitive load experienced by readers. Similar claims can be made about the state of scholarly research focused on digital texts and on-screen reading. Mangen (2013) outlines how much of the scholarly attention paid to on-screen reading and electronic reading devices is rife with “poor theorizing, ideology-ridden assertions, and uncorroborated claims” (p. 103) about the status of both print and digital texts. As a corrective measure, Mangen (2013) proposes that “our common discourse, research questions, and innovative projects [be] better informed by proper knowledge about the basics of human information processing” (p. 103). Knowledge of the integral role text shape plays in reading comprehension is one such basic of human information processing. While empirical studies on on-screen reading comprehension do exist, they generally fail to account for text shape in their research design and description of materials. When details about a studies’ test-text’s spatial and semantic structure are left out of published papers, essential information is discarded. Conflicting results in studies investigating on-screen reading comprehension (such as findings that suggest lowered, consistent, or heightened reading comprehension levels on screen compared to print) may be better understood if text shape were thoroughly described and analysed. Similarly, there is also a need for additional studies that investigate reading comprehension on screen for long information-rich texts, particularly those where maintaining conventional text-type structure is instrumental to text processing. To gain an understanding of how readers process long texts on screen, it is necessary to use a test-text of a representative length. By filling in the current gaps in the research, such as including better descriptions of test reading materials and using more representative text segments, both scholars and industry professionals will be in a better position to understand and design digital texts that support effective text processing and reader comprehension.

References


