universität wien

# DISSERTATION / DOCTORAL THESIS

Titel der Dissertation /Title of the Doctoral Thesis

## Print to Screen – The Consequences of Reading Narrative Texts Digitally


verfasst von / submitted by

Annika Schwabe, MSc BSc BA


angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Doktorin der Philosophie (Dr. phil.)

Wien, 2023 / Vienna 2023

| | |
|---|---|
| Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet: | UA 796 310 301 |
| Dissertationsgebiet lt. Studienblatt / field of study as it appears on the student record sheet: | Publizistik- und Kommunikationswissenschaft |
| Betreut von / Supervisor: | Univ.-Prof. Hajo G. Boomgaarden, PhD |

## Table of Contents

## List of Figures



## List of Tables

**Acknowledgements**

This dissertation would not have been possible without the support of the following people to whom I would like to express my deepest gratitude.

First, I would like to express my special gratitude to my supervisor Hajo Boomgaarden who supported me throughout the whole process of my doctoral studies. I thank him for being open to my research ideas and giving me the freedom to explore them independently but also guiding me when I needed help. I thank him for the encouragement to pursue the studies the way I did and his excellent constructive criticism.

Second, I thank Günther Stocker who (together with Hajo Boomgaarden) acquired the necessary funding and made this dissertation financially possible in the first place. But I also thank him for being a great boss who always made time for me when I needed his input and who introduced me to the academic community.

Further, I thank Lukas Kosch, the best colleague anyone could wish for. I really enjoyed the countless hours I spent bouncing my ideas off of him and conducting the studies with him. Without him this dissertation would look extremely different than it looks today.

Moreover, I thank the whole Computational Communication Lab, but especially Fabienne Lind who conducted one of the studies with me and Alina Nikolaou with whom I took most of my classes. They made my PhD time a lot of fun.

Additionally, I would like to thank my parents, my grandparents, my uncle, and my friends, especially Eike Wietzorek, Kim Lang, Vanessa Mitschke, Imke Kalkmann, Jessica Siderits, Caroline Kolmanz, Tina Zeman, Marlene Mürwald, and Verena Urban, for believing in me and supporting me on the one hand, but on the other, also taking my mind off my dissertation and reminding me that life is much more than the job.

Finally, I would like to express my deepest gratitude to my husband Frederik Ahrens for his unconditional emotional support throughout this entire process. It truly made a difference.

## 1. General Introduction

Nowadays, digital books are well established. They are present in educational and work settings as well as in recreational reading. Digital books are "books (or, for that matter, apps) that replicate the written and graphic materials you'd find in a printed book, but are accessed on a digital device (typically a tablet, but potentially a computer, eReader, or mobile phone). [… A]n enhanced digital book (or app) incorporates one or more of the add-ons that make digital reading potentially different from print" (Baron, 2021a, p. 68), such as dictionaries, hyperlinks, animations, sounds, and even games. The use of narrative and fictional e-books for leisure reading is increasing. In 2021, more than 38 million e-books, excluding textbooks, were sold in Germany, which represents about 5.7% of the total book sales (Börsenverein des Deutschen Buchhandels, 2022).

In light of these developments, some see the rise of digital reading devices as a transformation of reading rather than a threat to it. It is argued that where printed books fall short (e.g., portability and additional features), digital reading devices can complement printed books and enrich the reading practice (Kuzmičová et al., 2020). In contrast, critics worry that digital and print reading are not comparable in terms of reading outcome and that digital reading would negatively impact reading as a leisure activity (e.g., Wolf, 2018). In the 1964 published book, *Understanding Media: The Extension of Man*, McLuhan coined the phrase "the medium is the message" (1964/2001, p. 9). They described various media technologies, such as a book, a newspaper, or a television set, as non-neutral methods of communication, the impact of which on society goes beyond the actual content they are presenting. Even though they were not talking about screen reading media as opposed to printed media, their theory can be easily applied to this comparison.

It is still unclear whether, in the case where only the medium differs but the text and the reading goals stay the same, the reading processes and strategies learned by reading print automatically apply to reading digital as well (Baron, 2021a). Given the high numbers of e-book sales and theoretical notions of medium differences, it seems important to systematically understand and empirically demonstrate what the transition from purely printed to digital books means for reading practices and reading processes. Neuroscientists (e.g., Greenfield, 2015; Wolf, 2018) suggested that digital reading media would have effects on the brain and influence reading in general. "The very medium of the digital technologies, the screen itself and what lies behind it, might now be driving our thought processes in an unprecedented direction" (Greenfield, 2015, p. 225). They described that digital devices would negatively change their users' reading behavior and reading experience. According to their theoretical

considerations, the ability for concentrated reading would decline: “If the dominant medium advantages processes that are fast, multi-task oriented, and well suited for large volumes of information, as the digital medium, less attention and time will be allocated to slower, time-demanding cognitive and reflective functions, thereby compromising deep reading processes” (Wolf, 2021, pp. Xf.). Focused in-depth reading would be replaced by medium-driven shallow non-linear reading, browsing, and scanning (Liu, 2005; Liu & Huang, 2016).

Further, digital reading interfaces require skills in addition to general literacy that are essential for successful use, such as the navigation of complex text environments and the integration of different sources of information (Salmerón et al., 2018). However, those skills might be more required to successfully read in digital environments, where the information sources are fragmented, and the information needs to be collected and summarized by the reader, such as hyperlink-texts or information searches on multiple websites. In contrast, in reading environments, in which all the information is already enclosed and assorted, like an e-book, the need for those skills might not be fundamental for successful reading, especially when the text is a narrative story which is read linearly from the beginning to the end.

Moreover, these presented theoretical considerations might not reflect the reality of digital reading as it has not been conclusively established that these proposed negative effects of digital reading really exist when reading narrative texts. Two recent meta-analyses showed that in terms of reading comprehension, print reading is superior to digital reading when reading expository texts. However, these effects were not found for narrative texts (Clinton, 2019; Delgado et al., 2018). Nevertheless, these meta-analyses had a different focus and were therefore not exhaustive. Thus, an update would be beneficial to this academic discourse. Further, when reading narrative texts, probably even as important as reading comprehension are other cognitive and emotional reading dimensions and reading practices accounting for the reader’s reading experience. However, these other aspects have been barely studied for digital reading (Mangen & Kuiken, 2014).

Therefore, the goal of this dissertation is to empirically investigate the effects of e-books on the reading process of narrative texts. Accordingly, the overarching question of this dissertation is: *What are the consequences of the digitalization of narrative texts on readers?*

To answer this question, first a number of different concepts relevant to this research question (see Figure 1) are elaborated below. Based on the following considerations (Chapter 2. Concepts), three studies with three different methodological approaches were conducted. First, a survey study explored the use and differences in the use of digital reading devices and the effect of digital reading devices on reading practices. Second, a meta-analysis study

investigated the influence of reading narrative texts in print or digital on reading comprehension. Third, an experimental study tested how two different reading modes, print and digital, affect different cognitive and emotional reading dimensions. At the end of this dissertation, a summary conclusion from these studies is drawn and limitations are discussed.

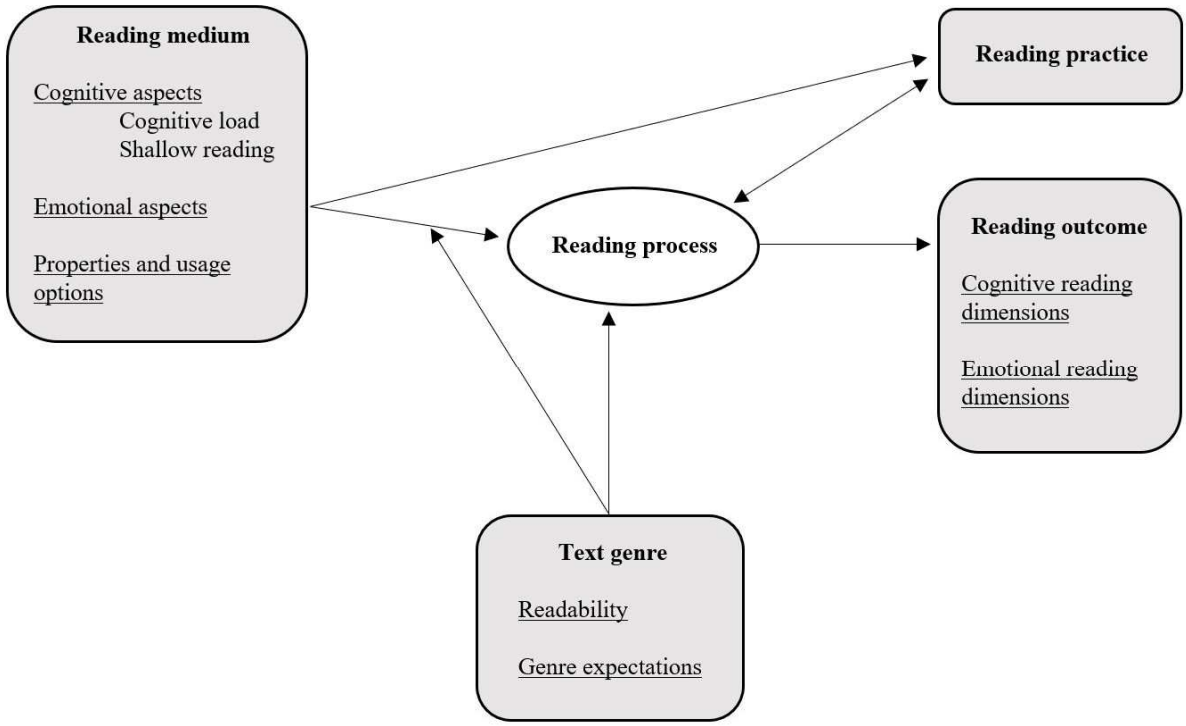
## 2. Concepts

Before answering the overarching research question, its components, the *digitalization* of book reading, the *consequences* of this digitalization, and the special case of reading a *narrative text*, and therefore its essential concepts (see Figure 1) need to be discussed first.

To digitize and to digitalize a text, there needs to be a digital platform presenting the text. By triggering different *cognitive and emotional aspects of reading*, these digital platforms might influence the reading process, resulting in differences in the reading outcome in terms of *cognitive and emotional reading dimensions*, and in differences in the reading practice. The reading process is the activity of creating a literal presentation of the text (such as an understanding of story elements like the characters, the setting, and the events described in the text), as well as the strategic and effortful process of creating a nonliteral representation (such as interpreting the deeper meaning of the text constructed by connecting the text with ideas and information from throughout the text as well as information from beyond the story; McCarthy, 2015). Further, digital reading devices vary in their *properties and usage options* from a printed book, but also from one another, offering unique features which might cater to or obstruct certain reading practices, in terms of who reads what, when, where, and for how long (e.g., Hupfeld et al., 2013; Kosch et al., 2021; Spjeldnæs & Karlsen, 2022). Additionally, the reading process differs between readers, between situations, and between genres.

However, recent meta-analyses showed that print is superior to digital when reading expository texts but not when reading narrative texts (Clinton, 2019; Delgado et al., 2018). Thus, the text genre might affect the reading process and the influence of the reading medium on the reading process. Therefore, the *differences between narrative and expository texts* are also discussed below.

**Figure 1**
*Concepts of the Dissertation*




## 2.1. Digital Reading Devices

### *2.1.1. Cognitive and Emotional Aspects of Digital Reading*

When reading linear texts with the same reading goal, the reading strategies, such as reading from top to bottom, skimming, or rereading, should be the same regardless of the reading mode, and print-reading strategies should also apply for digital reading. However, when reading non-linear digital text, the strategies might vary, as different information sources need to be integrated (Baron, 2021a; Salmerón et al., 2018). Similarly, Coiro (2021, p. 21) proposed, following print reading processes, that "at least five processes influence comprehension in digital spaces […:] Attend to and remember information […, m]onitor and self-regulate one's understanding of information […, c]ritically evaluate information for a number of purposes […, i]ntegrate and synthesize information [… and, p]rocess information at deep levels." Variations in these processes, however, could lead to sufficient as well as to insufficient comprehension when reading linear and non-linear texts. All of these processes could be compromised due to learned shallow reading or too much cognitive load when reading digitally. Moreover, they could be impaired by negative emotions towards digital reading but could also be fostered by a positive attitude towards digital reading (see Figure 1).

#### 2.1.1.1. Shallowing Hypothesis.

The shallowing hypothesis proposes that frequent Internet usage and its form of information presentation would lead to a decline in the ability to concentrate deeply over a longer period of time. Short text passages of many different sources are designed to be quickly skimmed and scanned and to forward the reader via hyperlinks and scrolling to the next bit of fragmented information. With the help of search and filter tools, this type of information acquisition is efficient, but it also leads to different reading strategies than those learned by reading linear books, which, in turn, might spill over to other cognitive tasks (Carr, 2010).

People frequently using social media or texting are less likely to engage in reflective thinking (Annisette & Lafreniere, 2017). However, it is unclear whether this relationship is really causal or merely a correlation. In favor of this finding are the experimental results of Jiang et al. (2016). They showed that after active interaction with a micro-blogging page, the participants scored lower on a reading comprehension test than participants who were just reading the micro-blogging messages in a given order. Additionally, reading strategies learned by using digital reading devices for other reasons could be linked to the device or digital reading devices in general. Thus, the same strategies for using a web browser or social media app would be applied when reading a linear e-book, resulting in shallow and superficial reading behavior (Carr, 2010).

However, the empirical investigations do not support this theory completely. The results of the last Programme for International Student Assessment (PISA) evaluations show a negative association between the use of digital reading devices for other activities and digital reading achievement, but a positive association between the frequency with which digital reading devices are used for reading and the PISA comprehension test (Kong et al., 2022), so frequent digital readers might use different reading strategies than other users of digital reading devices. Thus, the shallowing hypothesis might not be applicable to frequent digital readers who have already learned to read and navigate a linear text digitally. But again, these associations might not be causal, and even if they were, the direction of what affects what is unclear. Further, the results of eye-tracking studies exploring the difference in visual patterns when reading in print or digital are also ambiguous. Some eye-tracking studies concluded that the eye movements are similar across reading modes and across digital reading devices, some found significant shorter fixation durations and more fixation points when reading digitally compared to print devices, and some found different patterns even between screen types (e.g., Delgado & Salmerón, 2022; Jeong & Gweon, 2021; Kretzschmar et al., 2013; Siegenthaler et

al., 2011; Zambarbieri & Carniglia, 2012). Furthermore, a faster reading time when reading a digital text compared to a printed text would indicate a shallower reading behavior with skimming and scanning. Yet, the reading speed does not depend on the reading mode and is similar between digital and print reading (Clinton, 2019).

Nevertheless, the shallowing hypothesis might be especially relevant for the reading of narrative texts, as not only might reading comprehension be affected by inconvenient reading strategies and reading behavior, but also other reading dimensions important for the reading experience, like absorption (for definition see Chapter 2.2.2. Cognitive and Emotional Reading Dimensions), which is dependent on concentrated reading (Kuijpers, 2021).

#### 2.1.1.2. Cognitive Load Theory.

The duration and capacity of the working memory are constrained, which becomes problematic when dealing with new information and complex tasks (Sweller, 2005). The cognitive load theory describes how the sparse cognitive resources of the working memory are allocated during learning and problem-solving, and that irrelevant cognitive activities divert the focus from the main task, hindering the successful execution of this task as the cognitive load is too much to ensure successful processing (Chandler & Sweller, 1991; Sweller, 2005).

Reading, in general, is affected by the performance of the working memory. In particular, individual differences in the ability to update and retain verbal information, as well as differences in the attentional resources and the attentional control mechanisms account for the inability to process verbal information successfully (Carretti et al., 2009). The working memory also affects the reading performance when reading digitally (Margolin et al., 2018). In digital reading, there are a few additional obstacles compared to print reading that could increase the cognitive load and thus affect cognitive processing. A cognitive map of a text is a cognitive representation of where in the text which certain information is located. The ability to create a cognitive map of the text highly benefits reading comprehension and memory (Baron, 2021b). When the possibility of constructing a cognitive map is limited, more cognitive resources are needed for the reading process (Hou et al., 2017). However, this is the case with digital reading, as the construction of a cognitive map is constrained by a digital reading device (Shi et al., 2020). A text shown on a digital reading device lacks a fixed layout with a fixed spatial placement of information, which would help with the orientation within a text and the creation of a cognitive map (Hou et al., 2017). Additionally, a printed book is a three-dimensional reading medium, whereas an e-book is only displayed in two dimensions.

Thus, crucial sensorimotor cues, such as where a specific piece of information is placed within a book and where it is placed on a page, are limited when the text is displayed on a digital reading device. Nevertheless, this information is important for the construction of a cognitive map (Li et al., 2013). Thus, the cognitive load might be higher without sensorimotor cues. An indication of this is that when reading digitally, the memory in terms of chronology and temporality might be worse than when reading in print (Mangen et al., 2019). Therefore, a correct temporal representation of a story might rely on a coherent spatial representation of the text, which might be more challenging to acquire when reading an e-book lacking sensorimotor cues, and thus requiring more and eventually too many cognitive resources. However, signals (or cues) that do not add extra information but highlight or structure the text, such as words or sentences in bold font or headings, which can be implemented in e-books, reduce the cognitive load as the reader does not need cognitive resources to find particular important parts of the text (Shi et al., 2020).

Nevertheless, according to the *Cognitive theory of multimedia learning*, both verbal and pictorial information are processed through different channels and need to be integrated for a coherent mental representation, which requires additional resources. Thus, unfavorable designs of multimedia features might add to the cognitive load, evoking a cognitive overload (Mayer & Moreno, 2003). An indication of this is that story-incongruent interactive and multimedia features, which add irrelevant information, affect the reading process and story comprehension negatively (Furenes et al., 2021; Takacs et al., 2015). However, interactive and multimedia features can fulfill the same function as signals reducing the cognitive load as story-congruent features benefit the reading process and story comprehension (Furenes et al., 2021; Takacs et al., 2015).

In sum, digital reading devices could support or hinder the right allocation of limited cognitive resources needed for a successful reading process.

#### 2.1.1.3. Emotional Aspects of Digital Reading.

Emotions are especially important for reading narrative texts as the purpose of reading is mainly entertainment (see Chapter 2.2. Narrative Texts). Positive reading emotions lead to higher emotional, cognitive, and behavioral engagement with the text (Hamedi et al., 2020). Additionally, a positive valence of a text improves information processing, while a negative valence of a text has the opposite effect by hindering information retrieval (Megalakaki et al., 2019). Thus, emotions are vital for text processing.

Digital reading devices affect the haptic, perceptual, and aesthetic experience of reading and, therefore, can also influence the reader's emotional response and reading behavior (e.g., Baron et al., 2017; Kaakinen et al., 2018). In the context of interactive media, among others, the positive assessment of the interface is a predictor of cognitive absorption and, subsequently, of user engagement (Oh et al., 2018). Further, more pleasurable and well-designed interfaces are also more memorable and affect the attitude towards the text's information positively (Naylor & Sanchez, 2018; Tuch et al., 2009). Thus, the emotions induced by a text and its form of presentation are important aspects of the reading experience and the reading process.

Furthermore, the motivational aspect *reading task value* is also important for the reading process (Anmarkrud & Bråten, 2009). Therefore, the idea is not far-fetched to suggest that emotions towards digital reading could impact the reading process when reading digitally. The general emotions and attitudes towards digital reading might affect the reading device's interference in the reading process and can therefore influence the reading experience and the reading outcome positively or negatively. An indication of this is that the preference for a specific reading mode and, therefore, the attitude towards digital reading has implications on the emotional aspects of fictional reading. Guarisco et al. (2017) explored the association of the reading mode and the prosocial effects of fiction reading and suggested that reading a story on a digital reading device might impact the development of empathy and theory of mind differently than reading the same story in a printed book, depending on individual preferences of reading mode. Additionally, people with higher tablet familiarity perform better in a comprehension test than people with lower tablet familiarity when reading on a tablet (Chen et al., 2014). Similarly, children score higher in digital reading tasks when they have a positive attitude towards using technology (Hu & Yu, 2021). In contrast, people with higher technophobia read more slowly and feel more general discomfort and increased fatigue when they read digitally than people without or with less technophobia (Hou et al., 2017). Thus, people might be more distracted by a digital reading device when they have a more negative mindset toward the device, and a negative mindset toward the reading device might lead to a more negative evaluation of the reading experience.

Therefore, emotions evoked by a digital reading device and emotions towards digital reading could be essential factors in the digital reading process.

### *2.1.2. Properties and Usage Options of Digital Reading Devices*

Reading practices and the reading process could also be dependent on what a digital or non-digital reading device has to offer to a reader (see Figure 1). Only if a device has a certain feature, a fitting practice can be developed by a reader. Its materiality, its physical attributes, and its functionality affect how a technology or an object can be used (D'Ambra et al., 2019 Evans et al., 2017). Even though the primary purpose of being a text carrier is the same, the benefits and constraints of a printed book or a digital reading device differ in various ways. Additionally, different reading devices, like an e-reader, a tablet, a smartphone, or a computer, have similar but also device-specific properties and usage options, which could impact the reading process and the reading practice positively or negatively (as discussed below). The digital reading experience consists of four elements: the *activity*, i.e., the actual reading of the text, the *reader* performing the activity, the *text* being read, and the *context* in which this activity, the reader, and the text occur. The activity of reading includes the purpose, the process, and the consequences of reading. Further, the activity of reading is affected by the digitization and digitalization of book reading, especially through varying properties and usage options of digital reading devices connected to the context, the text, and the reader (Coiro, 2021). Hence, these three concepts are further discussed below.

*Context.* Coiro (2021) describes the reading medium or the reading platform as part of the reading context, which, among others, includes the technical aspects such as the device or the software of those reading platforms. Hand-held reading devices can foster the reading practice as they are lightweight and portable, facilitating reading anywhere and at any time. As many people carry a smartphone with them anyway, an additional device is not needed. This allows people to read in situations where they usually would not (Hupfeld et al., 2013). Digital reading devices also provide more privacy than a printed book, as book covers are not visible to the people around the reader (Hupfeld et al., 2013). Moreover, even difficult light conditions for reading can be counterbalanced with adjustable background light without the need for an external light source when using a digital reading device (D'Ambra et al., 2019; Hupfeld et al., 2013). If appropriately used, adaptive brightness and contrast affect the reading performance positively (Benedetto et al., 2014; Kretzschmar et al., 2013). Thus, adjusting the background light is undoubtedly a convenient feature, however, it also affects the cognitive reading process.

An important factor of digital reading devices is the availability of books. Digital reading devices can, in principle, hold as many books as the reader desires without additional

weight or physical storage space needed (D'Ambra et al., 2019; Hupfeld et al., 2013). Further, additional books are available anywhere with an Internet connection (D'Ambra et al., 2019; Keller, 2012), often even cheaper than a printed book or, in the case of public libraries or illegal download websites, for free (D'Ambra et al., 2019; Hupfeld et al., 2013; Kosch et al., 2021). This can change reading habits and encourage *binge reading*, as new books can be purchased immediately after finishing a book without having to wait for a bookstore to open (Kosch et al., 2021). It is also possible to obtain usually harder-to-get books, such as foreign-language books, books out of print, or the latest edition of a book, without waiting for an order to arrive (Keller, 2012; Kosch et al., 2021). Further, device-specific bookstores and general online platforms providing new reading material can impact reading practices. Through special offers or very low-priced books, recommendations of books based on previous purchases, and the opportunity to read samples before buying a book, readers discover books and genres they probably would not likely have considered before and buy more books than they usually would (Hupfeld et al., 2013). Moreover, environmentally conscious readers buy more books than they usually would because no extra paper is needed for printing them (Bansal, 2010; D'Ambra et al., 2019; Hupfeld et al., 2013).

Software features can also enhance the reading process and reading practice. Collaborative annotations can foster comprehension and make it a social reading experience when those annotations are shared with acquaintances and even strangers (Clinton-Lisell et al., 2021; Rowberry, 2016). Device-specific software can also help to manage the reading material by tracking the reading progress within books and by organizing books that have already been read as well as the books in line to read (Hupfeld et al., 2013). However, if the reader does not know how to handle the software correctly and has problems navigating this virtual space, it can be a distraction from reading (Nikolakopoulos & Paraskeva, 2014). Additionally, other services provided by multimedia devices with Internet access (smartphone, tablet, or computer), such as messaging services, social media, or other reading and browsing services, can also distract the reader from reading the book (Bowman et al., 2010; D'Ambra et al., 2019; Keller, 2012).

*Text.* Next to the actual text and its content and linguistic features (see Chapter 2.2.), the text read on a digital reading device can be designed for reading in print embedded in a digital environment and enriched with digital features, but it can also have additional features designed especially for reading digitally (Baron, 2021a; Coiro, 2021). Digital reading devices have a hypertext function that allows the reader to access glossaries, dictionaries, and

encyclopedias (Dalton & Proctor, 2007; D'Ambra et al., 2019; Keller, 2012). As these functions provide immediate answers to unclear vocabulary or other questions, they have a positive effect on text processing (Clinton-Lisell et al., 2021; Dalton & Proctor, 2007; D'Ambra et al., 2019).

Multimedia devices also offer other features when reading digital books. However, some of them help with the reading, while others are distracting and sabotage the reading process. Particularly helpful for reading comprehension, especially for non-proficient readers or for studying, are read-aloud options and digital tutors explaining reading strategies or asking questions about the text (Clinton-Lisell et al., 2021; Dalton & Proctor, 2007; Nikolakopoulos & Paraskeva, 2014). For children, story-congruent multimedia features can be beneficial when reading a storybook without an adult and thus without the adults' attention guidance to particular relevant events and characters of the story (Furenes et al., 2021; Takacs et al., 2014). These story-congruent features can be, for example, animated illustrations, matching background music, and sound effects (Takacs et al., 2014; Takacs et al., 2015). However, story-incongruent features distract from relevant parts of the story and therefore hinder story comprehension, such as mini-games and story-irrelevant animated hotspots (Takacs et al., 2015; Zucker et al., 2009).

*Reader.* The reader is confronted with these different properties and usage options, which require different cognitive capabilities and reading competencies (Coiro, 2021). However, some features can be particularly helpful for readers challenged with reading in print (Dalton & Proctor, 2007).

Digital reading devices can help readers with manual-dexterity impairments (D'Ambra et al., 2019) as they can be operated with one hand or even without hands (Hupfeld et al., 2013). While a computer can be placed on a table, a hand-held digital reading device is lightweight and compact, making both easier to use than a hardcover book. Turning a page is also easier using a digital reading device than when using a printed book, as it can be done with a click (D'Ambra et al., 2019). Also, readers with a visual impairment can benefit from reading digitally (Dalton & Proctor, 2007) as the background light, the font, the font size, and the line width can be adjusted. Even the font and background color can be switched (black background with white or grey font), which can be less eye-straining than the standard black font on white background (D'Ambra et al., 2019). Digital reading device features can also be beneficial for readers with dyslexia (Cavalli et al., 2019; Dalton & Proctor, 2007). As the appearance of a text can be individualized, it can be fitted to serve the reader's needs. For

example, it has been shown that shorter lines and wider within-word and between-word spacing are beneficial for readers with dyslexia, making it even easier for people with dyslexia to read on an iPod than in print (Marinus et al., 2016; Schneps, Thomson, Chen et al., 2013; Schneps, Thomson, Sonnert et al., 2013). Further, the read-aloud function of single words or sentences can help to recognize difficult words, and the highlighting of important words can help to make sense of sentences or paragraphs (Dalton & Proctor, 2007). The read-aloud option, the dictionaries, and the glossaries are also helpful for people reading in a second language, and dictionaries and glossaries are beneficial to people whose first spoken language is sign language (Dalton & Proctor, 2007).

## 2.2. Narrative Texts

### *2.2.1. Difference Between Narrative and Expository Texts*

Further, the effect of the reading medium on the reading process could be affected by the text genre (Figure 1), thus the findings of digital reading gathered through research on expository texts cannot easily be transferred to the reading of narrative texts. Even though the activity *reading* is quite similar when reading a narrative or an expository text, it is not the same and must therefore be distinguished from another. In this dissertation, the word *text* refers to a sequence of written sentences connected in a meaningful manner, thereby excluding audio, picture, and video presentations. Further, a distinction is made between *expository texts* (in Study 3, also called *informational* texts) and the umbrella term *narrative texts* for fictional and non-fictional *life narratives* (emotionally laden, straightforward stories) and *literary narratives* (stories higher in foregrounding; Koopman, 2015a). Superficially, the main difference between a narrative text compared to an expository text is the author's intent to tell a story from a specific point of view containing a temporally organized plot, including a theme or message, characters, and a setting (Ayres, 2008). Nevertheless, beyond that, texts of these two genres also vary in their key features: textual features and content.

#### 2.2.1.1. Differences in Readability.

*Textual features.* On the textual level, narrative and expository texts are dissimilar in some aspects, contributing to different levels of readability. While a few aspects suggest a higher readability of expository texts, most arguments point to a higher readability of narrative texts.

The overall sentence length is generally longer in narrative texts than in expository texts, which would make expository texts easier to read. However, expository texts contain

more complex and longer words with more letters and syllables, which reduce their readability (McNamara et al., 2012). Nevertheless, word and sentence length alone do not account for text difficulty (Graesser et al., 2004). The sentences in narrative texts are usually longer because they utilize structure-giving connectives (e.g., “until then,” “before,” “also,” “furthermore”) more frequently than in expository texts, aiding in the assessment of cohesion (Graesser et al., 2004; McNamara et al., 2012).

However, there is less variance in the use of words in expository texts, which use the same words multiple times, while in narrative texts, usually different topics with a more extensive vocabulary are described (McNamara et al., 2012). Using the same words in a higher frequency contributes to the texts’ readability (Chen & Meuters, 2018). In general, narrative texts contain a more accessible vocabulary related to human characteristics, such as emotions and physical features (Gardner, 2004). Emotional words and sentences presented in a text are recalled better than emotional neutral words and sentences (Kim et al., 2021; Megalakaki et al., 2019). In contrast, in expository texts, the vocabulary is often content-based, informational, and scientific (Gardner, 2004). Nevertheless, Kulesz et al. (2016) reported that even when word frequency, sentence length, cohesion, and the readers’ vocabulary and reading ability are controlled for, readability is higher for narrative texts. Therefore, factors other than textual features also yield great relevance for readability.

*Content.* Another reason for the easier readability of narrative texts is the content. While specific linguistic markers, such as explicit words, sentences, and connectives, are undoubtedly crucial for the reading process, they are merely an aid in guiding the readers to connect the ideas of a text in a meaningful and organized way (Graesser et al., 2003).

The purposes of narrative and expository texts are different, resulting in different starting positions for comprehension. Narrative texts’ primary purpose is entertainment, drawing on relatable (everyday) life experiences, such as person-oriented plots in certain settings with characters differing in personality traits, goals, and mental states, and with certain obstacles to overcome through characters performing some kinds of actions (Graesser et al., 2003; McNamara et al., 2012). In contrast, the purpose of expository texts is to impart information and concepts the readers are mostly unfamiliar with (McNamara et al., 2012). The content is more abstract and less relatable to everyday life experiences compared to narrative texts (Graesser et al., 2003). Therefore, narrative texts might be easier to understand than expository texts.

However, for comprehension, less coherent texts with structural and conceptual gaps require prior knowledge to fill these gaps (Graesser et al., 2003). In this case, the readers need to make inferences by activating their background knowledge. Background knowledge is specific and generic information relevant to the text, which on the one hand, consists of memory representations of relevant parts of the same text, but on the other hand, also of memory representations of other texts and particular experiences (Graesser et al., 1994). Background knowledge is the most important reader characteristic for predicting reading comprehension (Kulesz et al., 2016). Nevertheless, the background knowledge needed to understand a narrative text with relatable situations and storylines is different from the background knowledge needed to understand expository texts with a specific unfamiliar topic (Grasser et al., 2003). While for narrative texts decoding skills are more critical for comprehension, the comprehension of expository texts mainly relies on prior knowledge, which readers reading expository text to learn about a topic often do not have, and therefore cannot use, or their knowledge is incorrect resulting in insufficient comprehension (Best et al., 2008; Graesser et al., 2003; Kendeou & van den Broek, 2005; Wolfe & Woodwyk, 2010).

In summary, although there are some textual aspects of expository text, making them less challenging to read, overall, narrative texts are usually considered to be less challenging to read and the content easier to recall (Collins et al., 2020; McNamara et al., 2012). Two recent meta-analyses support this claim. Mar et al. (2021) found better memory and general comprehension for narrative texts than for expository texts. Similarly, Clinton et al. (2020) reported that the inferential comprehension of narrative texts is better than the inferential comprehension of expository texts, even when moderating variables, like readability, readers' age, and type of inference, are controlled for.

#### 2.2.1.2. Genre Expectations and Text Processing.

The aspects discussed in the previous section demonstrate an overall higher readability of narrative texts, which would lead to higher reading comprehension when reading a narrative text compared to reading an expository text. Yet, studies suggest that not only do the text-dependent features, such as the textual features or the required background knowledge, vary between narrative and expository texts, but also that the cognitive processing of texts of the two genres is different.

Paratextual information, such as the text's genre, affects the cognitive reading process. Even when the exact same text is read, partially different brain regions are activated depending on which genre the readers believe they are reading (Altmann et al., 2014).

Behavioral studies suggest that the paratextual framing of a text leads to different reading strategies and different reading outcomes. Zwaan (1994) showed that the reading outcome was different when the same newspaper articles were either framed as expository texts or narrative texts. The participants who believed they were reading a narrative text read significantly slower than the participants who believed they were reading an expository text. Further, the participants in the narrative condition were better at retrieving information about textual features, while the participants in the expository condition were better at making inferences. An explanation could be that the readers in the narrative condition did not know which information might be relevant at a later point in the text and therefore spent cognitive resources on probably irrelevant information, while the readers in the expository condition were keener on grasping and understanding the described concept (Wolfe & Woodwyk, 2010; Zwaan, 1994).

Additionally, while readers of narrative texts make more predictions, thus allocating cognitive resources to further parts of the text they have not yet read, readers of expository texts use their cognitive resources to connect the content with background knowledge which facilitates comprehension (Narvaez et al., 1999). Further, readers seem to adopt a more critical perspective of the text and their own reading comprehension when reading expository texts, while they are more involved with their aesthetic and emotional evaluation of the text when reading a narrative text (Lee, 2011; Narvaez et al., 1999), which is consistent with their usual reading purpose. As narrative texts are mostly read for entertainment and expository texts for obtaining information, they vary in purpose (Graesser et al., 2003). However, different reading purposes also affect which information and aspects of a text are seen as important, and therefore the processing resources are allocated to them. Even when the same text is read, when reading for studying, readers make causal connections to earlier parts of a text and concentrate more on their understanding and memorization of the information than when reading for entertainment. In contrast, when reading for entertainment, readers make more irrelevant general associations, which do not contribute to comprehension, and evaluate more frequently their opinion about the text (Linderholm & van den Broek, 2002).

Thus, depending on the reading purpose and the readers' genre expectations, readers allocate their cognitive resources differently, resulting in different cognitive processes.

In sum, text characteristics related to genre, such as the readability and genre expectations, may thus lead to different outcomes in reading comprehension and the reading experience (discussed below).

### *2.2.2. Cognitive and Emotional Reading Dimensions*

The different reading dimensions described below are not exclusively phenomena of the reading of narrative texts but also of the reading of expository texts and the reception of audiobooks, movies and television series, and certain kinds of video games (Green et al., 2012). Even though the different reading dimensions will be explained separately, they are not independent of each other. They are affected by and affect each other (see, e.g., Green et al., 2004; Green et al., 2012; Green & Brock, 2000; Komeda et al, 2009; Koopman, 2016; Kuiken et al. 2004). Further, their classification as cognitive reading dimensions and emotional reading dimensions does not represent a hard split between the reading dimensions but merely a rough division of the dimensions, with many overlapping characteristics. The *cognitive reading dimensions* have emotional attributes while the *emotional reading dimensions* also consist of cognitive elements. Further, the list of dimensions described below only addresses the reading dimensions explored in this dissertation and is far from exhaustive.

*Cognitive reading dimensions.* The reading dimension explored most in this dissertation is *text comprehension*. "[T]ext comprehension is not merely the sequential decoding of words, but rather the construction and maintenance of what these words represent as a whole, across words and across sentences." (Quinlan & Mar, 2020, p. 467). Next to the literal comprehension of the text, inferences are an essential part of comprehension connecting the literal information with background knowledge and imagination by creating and updating mental models or situation models of the described characters, settings, and events (Clinton et al., 2020; Quinlan & Mar, 2020).

Further, there is the broad dimension of *absorption into a story* (also called transportation, immersion, entrancement, or narrative engagement), which describes the state of being fully engaged in a story and less aware of the real world and the self (Busselle & Bilandzic, 2008; Green et al., 2004; Green & Brock, 2000). It entails an attentional aspect, imagery, and feelings (Green & Brock, 2000). On the psychological level, the reader is distant from reality, and the reader's *focus of attention* is completely on the story (Green et al., 2012; Green & Brock, 2000). At the *end of the reception*, the reader has the feeling of coming back from another world (Appel et al., 2001). Additionally, the readers experience vivid mental images of the described characters and settings (*imaginability*; Green et al., 2012) and the feeling of being actually there (*spatial presence*; Klimmt & Vorderer, 2003).

*Emotional reading dimensions.* Emotional reading dimensions or feelings during literary reading can be divided into four types of feelings: evaluative feelings, narrative feelings, aesthetic feelings, and self-modifying feelings (Miall & Kuiken, 2002).

The evaluative feelings are probably the reader's main goal in reading. They often entail feelings about feelings and thus evaluate the other three types of feelings (Miall & Kuiken, 2002). They describe the general feelings towards the text, such as the *general reading pleasure* and *excitement*, which are affective responses with physiological and cognitive aspects, but also the *thematic interest* and *ease of cognitive access*, both of which can foster reading pleasure (Liebers & Schramm, 2017; Miall & Kuiken, 2002; Vorderer et al., 2004).

The narrative feelings are direct emotional responses evoked by the narrative, such as the *emotional involvement* in the story or with characters (Miall & Kuiken, 2002). While *sympathy* is the feeling of concern for a character, *empathy* goes even further by feeling the same feelings as a character (Koopman, 2015a). *Empathic distress* usually occurs when witnessing pain in others, but it can also be experienced in response to the story during reading (Koopman, 2015b). In contrast, a different angle of the feelings towards a character is the *parasocial interaction,* where the reader experiences a (one-sided) relationship and interaction with a character as if they were a real person in their life (Appel et al., 2002; Rain & Mar, 2021).

The aesthetic feelings are a response to the generic, narrative, and stylistic features of the text, such as the perceived *foregrounding*, a positive feeling towards the literary stylistic features, or the *analyzing reception*, and the rating of the text's *attractiveness,* which are both the distanced evaluation of those features (Appel et al., 2002; Koopman, 2015b; Miall & Kuiken, 2002).

The self-modifying feelings are based upon the other types of feelings and refer to the part of the reading process the reader individually adds to the story, which goes beyond the literal text and its boundaries (Miall & Kuiken, 2002). Through the reader's *cognitive involvement*, which is essentially thinking about the story while reading and creating inferences connecting the story to general knowledge and personal memories, the text acquires an individual interpretation and new layers (Appel et al., 2002; Miall & Kuiken, 2002). Further, background knowledge and memories are able to become fresh feelings through metaphors of personal *identification* as the reader and character merge into one person and thereby possibly transform the reader (Cohen, 2001; Miall & Kuiken, 2002).

In sum, we see that digital reading devices differ from printed books in their properties and usage options and thus with the accompanied cognitive and emotional aspects could potentially affect the reading process and therefore the reading outcome and the reading practice. Additionally, the relationship between the digital reading device and the reading process might vary between different text genres (see Figure 1).

## 3. Methodological Approach and Contribution of this Dissertation

In academic research, the topic of digital reading is becoming increasingly relevant as exponentially more articles are published over the years, and exponentially more researchers enter the field (Dantas et al., 2017; Kolle et al., 2018). However, not much is known about the consequences of digital reading devices, especially for leisure reading and the reading of narrative texts. As proposed before, the overarching question of this cumulative dissertation is:

*What are the consequences of the digitalization of narrative texts on readers?*

In order to answer this question, four main research questions will be answered with different methodological approaches addressing various research gaps.

### 3.1. Main Contributions of this Dissertation

#### *3.1.1. Research Questions*

*Differences in the use of digital reading devices.* Singer and Alexander (2017, p. 1035) concluded in their review about digital reading research that "we must arm ourselves with empirical evidence of *when*, *where*, and *for whom* greater benefits are accrued from reading in print, digitally, or in combination." However, before asking about the benefits of digital reading, there is a need to step back and instead ask when, where, and by whom digital reading devices are actually used to read. Especially in the field of leisure reading, as when people have the opportunity to choose their reading medium more freely than in an educational or professional setting, these questions have only been sparsely explored in the past. At least in the United States, there are demographic differences between e-book adopters and print readers. Younger and higher educated persons are more likely to read an e-book compared to older or less educated persons (Faverio & Perrin, 2022; Perrin, 2016). In contrast, the role of gender as a crucial factor for digital book reading is unclear (Faverio & Perrin, 2022; Perrin, 2016; Zhang & Kudva, 2014). Thus, the influence of demographic differences on the use of digital reading devices for book reading needs further research.

Moreover, in a focus group study and a diary study, the participants described that digital reading expanded their reading practices in terms of genres, locations, and situations (Hupfeld et al., 2013; Kosch et al., 2021). However, while these studies build a great foundation, many more comprehensive and quantitative studies are needed to be able to generalize these results.

Thus, the first and second research questions concern the actual use of digital books for leisure reading. Since in most professional or education settings, the individual choice of reading digitally or print is limited and often predetermined by the circumstances, this part of the dissertation focuses on recreational reading when people use the reading mode they prefer and not the one someone else chose for them. Further, narrative texts are only a fraction of the texts read in educational and professional settings. Therefore, the first research question is:

**RQ1: Is there a difference in the reading practice when using digital reading devices or printed books?**

On the one hand, this research question contains the question as to whether there are individual differences between users of digital reading devices and print readers in terms of socio-demographic differences and reading motivation. On the other hand, this question also includes the question as to whether there is a difference in the amount of reading (books per year and minutes per week) done by digital and print reading persons, differences in their genre selection, and differences in their reading locations and situations. Further, the research question RQ1 implicates the question of whether there are preferred reading modes for specific situations, locations, and genres.

While RQ1 compares the current condition of the use of digital reading devices to printed books and compares the users of those different reading modes, RQ2 deals with an actual consequence of the use of digital reading devices and its effect on the reader's reading practice. The second research question asks:

**RQ2: Do digital reading devices diversify book reading in terms of how much, where, when, and what people read, and if so, how?**

*Effects on the reading experience.* When people are asked what they like most about reading, they talk, among other things, about emotional or aesthetic aspects (Baron et al., 2017). However, previous research on the difference between digital reading and print reading does not seem to acknowledge the importance of emotional aesthetic experiences. While many studies address performance-based measures, i.e., reading comprehension and reading speed, which are undoubtedly important factors, and research on them fosters the

understanding of the reading process, only a handful of studies explore the emotional or aesthetic aspects of reading (e.g., Guarisco et al., 2017; Haddock et al., 2020; Lange, 2019; Mangen & Kuiken, 2014, Mangen et al., 2019). Yet, the results of these studies are ambiguous and inconsistent. Therefore, more research is needed to understand the effect of the reading mode on the aspects studied in these (quasi-) experiments, like emotional reading dimensions, such as empathy, and cognitive reading dimensions, such as absorption, but also on other aspects (see Chapter 2.2.2. Cognitive and Emotional Reading Dimensions).

Therefore, the third and the fourth research questions deal with the immediate effects of digital reading devices on the reading outcome and the reading experiences compared to reading in print when reading a narrative text.

The third research question is:

**RQ3: Are there differences in cognitive reading dimensions between reading a narrative text digitally or in print?**

This question is manifold and addresses different aspects and influences on the reading comprehension as well as other more literary reading dimensions when reading digitally compared to printed text. It deals with the influence of the reading mode on reading comprehension in general but also on different types of reading comprehension. Further, it also includes the question of whether different types of digital functions and different types of digital reading devices affect reading comprehension differently compared to print and whether this changed over time. Additionally, RQ3 also implies the question of whether the reading mode affects the cognitive literary experience during reading. These experiences are as basic as the ease of cognitive access and the attention to the story, but also the for narrative texts relevant dimensions, like the imaginability, spatial presence, and absorption in the story. Moreover, the cognitive evaluation of the text and analyzing reception are also part of the cognitive literary experience during reading.

In a very similar manner, RQ4 covers the emotional side of narrative reading:

**RQ4: Are there differences in emotional reading dimensions between reading a narrative text digital or in print?**

RQ4 includes the question of whether the reading mode affects emotional responses to the texts. These emotional responses are, on the one hand, the general reading pleasure, excitement about the text, and emotional involvement in the story, but on the other hand, also parasocial feelings, like identification, sympathy, and empathy up to empathic distress.

### *3.1.2. Methodological Approach*

*Narrative texts.* This dissertation focuses on the reading of narrative texts in all three studies conducted because narrative texts seem to receive less attention from the research community than expository texts, yet they make up a large part of reading. Although there is already an extensive body of literature on the effects of the reading mode on the reading process, most of the studies were conducted in educational settings where expository texts were used as stimuli. The three most frequently cited meta-analyses that examine the association of digital reading and reading performance integrated approximately three to four times as many studies using an expository text than studies using a narrative text as stimuli (see Clinton, 2019; Delgado et al., 2018; Kong et al., 2018). However, the results of the studies using expository texts as stimuli cannot be directly transferred to narrative reading as narrative and expository texts and their reception differ considerably (see Chapter 2.2.1. Differences Between Narrative and Expository Texts). Empirical research supports this claim. The meta-analytic studies on the association of the reading medium with reading comprehension show that screen reading is inferior to reading in print when reading expository texts. In contrast, digital reading devices do not affect reading comprehension negatively when a narrative text is read (Clinton, 2019; Delgado et al., 2018).

*Leisure reading.* This dissertation bridges the gap between research on digital reading in leisure and study settings. In particular, Study 1 and Study 3 examine digital leisure reading habits and the consequences of digitizing leisure reading on the reading experience. Leisure reading is undoubtedly a major part of the *book reading* activity. While only about 57% of book readers report that they read for work or for school, about 80% state that they read for pleasure (Perrin, 2016). Nevertheless, in addition to entertainment, leisure reading has a positive effect on literacy and is a key factor in predicting reading performance (Torppa et al., 2018). Thus, it would be crucial to explore the effect of the digitalization of leisure reading. However, the predominant field of research studying digital reading is educational research, with a major proportion of articles dealing with the adoption of e-books in educational settings and with the impact of e-books on children's language skills and on teaching in general (Dantas et al., 2017; Kolle et al., 2018). Among the top five of the most frequent words used in the title of published articles are, next to *e-book*, *electronic book*, and *ebook*, *student* and *academic library* (Kolle et al., 2018).

*Adult readers.* In this dissertation, college students and schoolchildren were explicitly not chosen as samples in Study 1 and Study 3, rather the samples were composed of self-identified book readers of the general population over the age of 18 years old, because similarly and related to the point above, the focus of most studies is not on adult readers but on students. In their meta-analysis on the effect of digital reading on comprehension, Delgado et al. (2018) used 55 samples. However, most of them were student samples and only three of the samples included graduates or professionals, leading Delgado et al. (2018) to exclude these adult samples from some of the analyses and conduct the analyses with student samples only. Also, Singer and Alexander (2017) noted in their review on digital reading that most samples used in digital reading research consisted of college students. However, while a rationale for choosing this particular age group is mostly missing in the original articles, Singer and Alexander (2017) speculate that this age group is chosen due to convenience without theoretical or empirical implications.

*E-readers.* In Study 2, the differences between different digital reading devices compared to print in terms of reading comprehension were explored, and in Study 3, the difference in the reading performance and the reading experience between digital and print reading was studied by letting the treatment group read on an e-reader as research on e-readers is underrepresented. Print is still the most preferred reading mode for books (Baron et al., 2017; Faverio & Perrin, 2022; Loh & Sun, 2019). However, digital reading devices are on the rise (Faverio & Perrin, 2022), and the body of research on the differences between digital reading devices and print continues to grow. Beginning in the early 1980s, for about 20 years, the computer was the sole digital reading device used to study the differences between digital and print reading (see Delgado et al., 2018, supplements). Even after other digital reading devices have entered the market, the computer is still the medium of choice for researching the difference between digital and print reading (see Delgado et al., 2018, supplements). However, hand-held digital reading devices, such as tablets, e-readers, and smartphones, are just as popular or even more popular than a computer for reading books (Balling et al., 2019; Loh & Sun, 2019; Perrin, 2016). At least in Germany, the e-reader is the most popular digital reading device for reading e-books (PricewaterhouseCoopers, 2017). Therefore, there is a gap between the actual use of digital reading devices for reading books and the research conducted on this topic.

*Realistic comparisons.* In their commentary on 30 years of research on digital reading, Coiro (2021) criticized that researchers conducting systematic reviews and meta-analyses on digital reading only include the narrow part of the literature, which compares digital text mimicking printed texts to printed text instead of considering the complexities of digital environments. For example, interactive and multimedia features of a digital text, which have been shown to be an asset helping the reading process as well as a distraction from reading, have been mainly studied on preschool and primary school children (e.g., Furenes et al., 2021; Takacs et al., 2014; Takacs et al., 2015). In contrast, meta-analyses with a sample where the participants exclusively read themselves compared mainly printed text to static digital texts (e.g., Clinton, 2019; Delgado et al., 2018; Kong et al., 2018). However, this is a very artificial comparison because every digital reading device has, for example, a dictionary tool. Only Clinton-Lisell and their colleagues (2021), in their meta-analysis, compared digital expository reading material with interactive features to paper material or static e-books, using only samples of proficient readers, and found a positive effect of these interactive features on the learning outcome. However, a meta-analysis of the effects of additional features on reading narrative texts with samples of participants reading themselves has not been done before.

Therefore, this research gap was addressed in Study 2 of this dissertation.

By the overall addressing of these research questions with these methods, the dissertation makes an important contribution to the field of digital reading research, on the one hand in terms of building on the existing research conducted mainly with expository texts in educational settings in mind, and transferring it to the reading of narrative texts, and on the other hand by approaching important aspects of leisure reading such as the reading experience and reading practices.

### 3.2. Overview of Manuscripts

Three studies were conducted to address the research questions of this cumulative dissertation. All studies were written in collaboration with others and published in international journals relevant to the fields of psychology and communication science; for references, see Table 1.

In Study 1, RQ1 and RQ2 were explored by conducting a cross-sectional large-sample survey on Austrian women and men of all adult age groups. The sample consisted of self-identified book readers reading only printed books, only digital books, or printed books and digital books.

In Study 2, a meta-analysis study addressed RQ3. Several meta-analyses were performed summarizing the effect sizes of 32 studies that explored the differences in reading comprehension between reading a narrative text in print or digital.

In Study 3, to answer RQ3 and RQ4, an experiment was conducted on 207 adult self-identified book readers. The participants read the beginning of a high-brow novel either on a Kindle or in the original printed book and answered questionnaires about their reading experience and the text.

**Table 1**

*Overview of Manuscripts Compiled in this Dissertation*

| |
|---|
| **Study 1**<br>Schwabe, A., Kosch, L., Boomgaarden, H. G., & Stocker, G. (2022). Book readers in the digital age: Reading practices and media technologies. *Mobile Media & Communication*. https://doi.org/10.1177/20501579221122208 |
| **Study 2**<br>Schwabe, A., Lind, F., Kosch, L., & Boomgaarden, H. G. (2022). No negative effects of reading on screen on comprehension of narrative texts compared to print: A meta-analysis. *Media Psychology*, *25*(6), 779–796. https://doi.org/10.1080/15213269.2022.2070216 |
| **Study 3**<br>Schwabe, A., Brandl, L., Boomgaarden, H. G., & Stocker, G. (2021). Experiencing literature on the E-reader: The effects of reading narrative texts on screen. *Journal of Research in Reading*, *44*(2), 319–338. https://doi.org/10.1111/1467-9817.12337 |

# 4. Articles

## 4.1. Study 1: Book Readers in the Digital Age: Reading Practices and Media Technologies

Schwabe, A., Kosch, L., Boomgaarden, H. G., & Stocker, G. (2022). Book readers in the digital age: Reading practices and media technologies. *Mobile Media & Communication*. https://doi.org/10.1177/20501579221122208

*Original Article*

mmc

Mobile Media & Communication
1–24

DOI: 10.1177/20501579221122208
journals.sagepub.com/home/mmc


# Book readers in the digital age: Reading practices and media technologies

**Annika Schwabe**
Department of German Studies, University of Vienna, Austria;
Department of Communication Science, University of Vienna, Austria

**Lukas Kosch**
Department of German Studies, University of Vienna, Austria

**Hajo G. Boomgaarden**
Department of Communication Science, University of Vienna, Austria

**Günther Stocker**
Department of German Studies, University of Vienna, Austria

## Abstract

With the rising popularity of digital reading media, leisure reading is undergoing a transformation process. However, the reasons for readers to adopt e-book reading or to stick to traditional printed books are mainly unknown. Therefore, we explored demographic and motivational differences between print readers, digital readers, and readers using both reading media. We further studied their book-reading practices, like the amount of reading, the preferred genres, the different reading situations, and if there are dedicated reading media for specific genres or situations. Additionally, we explored if digital reading media have changed the reading process or just appeal to a certain type of reader. Therefore, we conducted a survey ($n = 779$) of adult book readers about their leisure reading behavior. The results show that print readers, digital readers, and readers using both media differ in age, gender, amount of reading, genre preference, and the situations in which they read. Furthermore, digital reading media especially foster reading on the move.

**Corresponding author:**
Annika Schwabe, Department of German Studies, University of Vienna, Universitätsring 1, 1010 Vienna, Austria.
Email: annika.schwabe@univie.ac.at

**Keywords**
Digitalization, digital reading, e-reading, genre preference, mobile reading, reading locations, reading practices

## Introduction

With the advancing digitization of our everyday lives and the widespread distribution of digital texts came the assumption that the printed book as a cultural asset and the reading of printed books would lose importance (e.g., Wolf, 2018). Through the metaphor of the death of the book, a powerful narrative was formulated that fundamentally addresses the impact of digital media on cultural, social, and economic practices (Ballatore & Natale, 2016). Nevertheless, as history shows, media rarely "die" (Lesage & Natale, 2019). Multiple technical and social innovations over time have not made the printed book disappear, and "the end of the book" is probably a misguided phrase (Eco & Carrière, 2011). Yet, new media and technologies always brought about new reading behaviors and practices (e.g., Chartier, 1995). In particular, e-books are accessed on multifunctional devices, which enhance the possible interactions with texts due to different affordances than the printed book (D'Ambra et al., 2019).

This makes it necessary to examine reading practices relating to the traditional printed book and to the new medium of e-books. Today, book readers are more than ever confronted with the conscious decision of whether to read in print or on a digital screen (Baron, 2021). The Pew Research Center reported that of the 75% of US adults who are saying they have read a book in the past 12 months, 32% say they read only printed books, 9% read only in digital formats (which in this study includes e-books and audiobooks), and 33% read both digital books and books in print (Faverio & Perrin, 2022).[1] These figures show that the e-book is far from displacing the printed book but that it has established itself as an important medium for the consumption of books. Above all, the Pew study is about leisure-time book reading, which must be distinguished from reading informative texts such as newspapers or reading for study in an educational context, where the choice of media and reading practices is quite different. As a growing number of people use printed books as well as e-books, it raises the question of what affects the selection of the printed book or the e-book and what differences in handling and reading practices go along with it.

The ongoing proliferation of digital and mobile reading devices and the increasing number of e-book users have inspired research on digital reading in recent years (e.g., Baron, 2021; Coiro, 2021; Kuzmičová et al., 2020). However, only a very small part of this research is concerned with who the people are who read books either only in print, only digitally, or through both media, and what their different and media-related reading practices are. Andersen et al. (2021) pointed out that the digital revolution's impact on the production and distribution of literature has already been discussed in detail, but how current media developments have affected readers has hardly been considered.

It is exactly this gap that is addressed through our study of book reading practices in the digital age. In particular, we focus on adult leisure-reading behavior, which is still a strong desideratum, because reading research is often strongly focused on children,

literacy, and reading competence. The present study explores how the increasing digitization of books shapes readers' leisure-time reading practices. It furthermore shows which aspects, such as genre selection, reading locations, reading situations, and the number of books read, relate to medium choices. The focus is on how the media shift has affected behavioral patterns and how the use of printed books has perhaps changed in view of its digital successor. In the following, we examine the usage of printed books and e-books. However, we do not conceptualize them as known and interpreted objects in the conventional sense, but rather, following Reckwitz's (2002) demand for praxeology, as objects to be handled and constitutive elements of forms of behavior. Drawing on a media-oriented practice approach, we explore, quite simply, what people are doing in relation to media across different situations and contexts (Couldry, 2010). Thus, the focus is less on different affordances and object properties of the reading device and more on the behavioral patterns that are triggered due to the choice of a certain reading medium.

To investigate the impacts of new media on established reading practices and how they differ from reading printed books, it is primarily necessary to understand who the individuals adopting digital reading devices in their book reading behavior are.

We investigate these issues of reading practices based on a large-scale survey conducted among habitual book readers, which was conceptualized in extension of prior focus group-based research (Kosch et al., 2021). This research suggests that e-books complement rather than replace printed books, and that book readers tend to diversify their reading in terms of purchase, genre selection, quantity, locations, and circumstances.

In the whole debate about the "end" of the printed book and the impact of reading on screens, it is time to survey actual reading behavior and focus on established reading practices. Our contribution is important in this regard because it reveals behavioral patterns that show how printed and digital books are handled in today's society and what specific practices have emerged.

## *Demographic and motivational differences in the adoption of digital reading devices*

Not everybody adopts digital book reading in their routine, but it is somewhat unknown which individual factors and situations foster digital reading. The simplest explanations for differences in digital reading adoption lie in demographic differences, like age, gender, and education, as they are often related to technology acceptance. However, the direction of the effect is unclear.

In a meta-analysis, Hauk et al. (2018) showed that perceived ease of use of the technological devices used for growth and knowledge acquisition decreases with age. One would assume that especially e-readers with the possibility of enlarging the font size and their limited functions could appeal to older readers; but the results regarding digital reading, in particular, are ambiguous. Among older adults, there is an increase with age in using printed books but not in using e-books (Taipale et al., 2021). Nevertheless, older people use a greater variety of digital reading devices compared to younger people. While younger people mainly use devices they already own, like

smartphones and laptops, older people can afford extra devices, like tablets (Balling et al., 2019). Thus, age could play a role in digital reading, but the direction of the effect is uncertain.

Furthermore, gender might also play a role in adopting digital book reading, but, again, the direction of this possible relationship is unclear. As reading history shows, at least since the end of the 18th century, women have read significantly more fiction than men (e.g., Schön, 1999), which still seems to be the case across different age groups (Baron, 2021). Since women have a higher interest in fiction reading in general, this could also lead to an increased interest in digital book reading and digital reading devices. Further, a meta-analysis has shown that girls perform better than boys in theoretical and applied digital literacy tests (Siddiq & Scherer, 2019). Thus, girls have a higher digital competence than boys. However, the results might not be transferable to adults because, in contrast, men rate their digital self-efficacy higher than women (Cai et al., 2017). Furthermore, there are still small gender differences in attitudes toward technology, with women favoring technology less than men. This effect has not systematically changed over the last 25 years (Cai et al., 2017), suggesting that, in general, newer technologies have not been able to close the gap.

Additionally, Cai et al. (2017) showed that with higher education, gender differences in attitudes toward technology do not vanish but at least decrease. Nevertheless, as most people own a mobile communication device (e.g., a smartphone), it is not surprising that the general adoption of mobile technologies is not correlated to education level. Also, education is not a significant predictor for using a mobile communication device for entertainment purposes if other demographic variables are controlled for (Thorson et al., 2015). Therefore, the influence of education on the adoption of digital book reading is unclear.

Another explanation for differences in digital reading practices could be another individual aspect. Print, digital, and multi-format users (who use both media) could vary in their motivation to read. Reading is a multidimensional and goal-directed activity, and so education psychology, in particular, has referred to the importance of motivation for the successful construction of meaning (e.g., Afflerbach et al., 2013; Conradi et al., 2014). By reading motivation, we mean the drive that results from "a comprehensive set of an individual's beliefs about, attitudes toward, and goals for reading" (Conradi et al., 2014, p. 154). The motivation and reasons to read a book can vary: they range from reading for pleasure, to pass the time, to get information, to learn something, or because you are asked to read (Baron, 2021). As we look at the leisure reading of books, it is the intrinsic motivation that we are interested in. As Thumala Olave (2020) has shown, e-books are mostly seen as practical and one-time use texts, while printed books have the status of individual and durable objects of value. Thus, it can be assumed that when reading e-books, the goal and motivation of entertainment could be predominant.

In sum, demographic and motivational differences could play an important role in adopting digital book reading. To examine how print, digital, and multi-format users differ from each other in their individual characteristics, we formulated the following questions:

1. What are the socio-demographic differences between the readers of printed books, e-books, and those reading both formats?

2. What are the differences in reading motivations between readers of printed books, e-books, and those reading both formats?

## Digital book reading practices

If different demographic conditions and different reading motivations can influence the adaptation of printed or digital books, the question then arises as to whether this also results in specific reading practices. As the primary reasons for starting to read e-books are mainly lack of space at home, the portability of digital reading devices, and the easy and immediate access to, at least in their own perception, a huge number of books, we can assume that digital readers have the need to read a large number of books and that the new medium extends their possibilities for reading in space and time (Kosch et al., 2021). Moreover, a consistent pattern has been the selection of a certain reading medium according to the genre and a subsequent appreciation of books after they have been read. Crime novels, thrillers, fantasy, and other light fiction are preferably consumed as e-books. In contrast, literary classics, in addition to personal favorite books, are purchased in printed form (Kosch et al., 2021). Thus, it can be assumed that different genres are read on different media.

Furthermore, before the reading process starts, people unconsciously or consciously decide where and when to read a particular book, at home or on vacation, during the day or at night, and sometimes this is also related to the subject matter of the text (Burke, 2010). Kuzmičová et al. (2020) further developed the embodiment constraint introduced by Mangen (2008) and referred to the situation constraint—that is, the fact that the reader's experiencing body is always embedded in an environmental and broader situational context. Therefore, next to the reading motivation and the genre, the reading situation and the reading place affect the reading experience and, moreover, the use of books and certain reading practices. The digitization of texts, which allows the retrieval of many texts on a single reading device, has naturally opened up new possibilities for reading in different locations and circumstances (Balling et al., 2019; Hupfeld et al., 2013). A large number of digital texts are thus bundled on one reading medium and can be accessed quickly and instantly, even at locations and in short reading times where and when the printed book would not have been taken (Kosch et al., 2021).

Thus, to explore how reading practices differ in terms of quantity, genre, and reading situations, the analysis of our data is guided by the following questions:

1. What are the differences between print, e-book, and multi-format readers in terms of the number of read books, genre selection, and reading situations and locations?
2. What is the preferred reading medium for specific genres, situations, or locations?

Lastly, we study if possible differences between readers were initiated by switching from print to digital reading, or if these differences were the reason to change from solely printed reading to (also) digital reading, using our last research question:

1. Do digital reading devices diversify book reading in terms of how much, where, when, and what people read, and, if so, how?

# Methods

## Sample

Our sample consists of adults living in Austria who frequently read books in their spare time. The online survey, administered in German, was quota-based (quotas set on age, gender, and education), distributed to 12,000 adults, and the response rate was 9.21%. In total, 1,041 participants agreed to take part in the survey. A filter question was used to differentiate between readers and non-readers, excluding 219 non-readers from completing the remainder of the questionnaire. Despite the low return rate, the sample quality seems good, given that the percentage of participants who answered that they would read books is similar to that in other studies (e.g., Faverio & Perrin, 2022). We excluded two participants who said they read a book zero minutes per week and zero books per year. Furthermore, we excluded 37 participants due to obvious mismatching answers (e.g., reading an average of 600 min per week, but only two books per year) or clear overestimation. Due to the low case number, we also excluded two non-binary participants and two participants who did not disclose their gender. The final sample contained 418 women and 361 men (a total of 779 participants) between 18 and 82 years of age (mean = 48.69 years, $SD = 15.22$). About 72.8% of the participants had finished secondary education and 27.2% tertiary education.

In total, 47.5% of the participants read books only in print, 43.3% read books in print and e-books (multi-format users), and 9.2% only read e-books. Of those participants reading e-books, 34.9% use an e-reader, 16.0% a tablet, 15.8% a smartphone, and 10.1% a computer or laptop. In the results section, we refer to participants using only printed books as print readers, to participants using only e-books as digital readers, and to participants using both reading media as multi-format users.

## Questionnaire

The participants provided information about their age, gender (i.e., female, male, non-binary, I don't want to disclose my gender), and educational level (nine Austria-specific categories, which we afterward coded as secondary and tertiary).

Furthermore, the questionnaire consisted of questions probing how many books participants read on average per year and how many minutes they read on average per week. Based on a focus group study (Kosch et al., 2021), we used a self-developed scale with nine items with a 4-point Likert scale exploring reading motivation. To create the subfactors of the reading motivation scale, we conducted an exploratory maximum likelihood factor analysis with varimax rotation, creating three distinct subfactors: escapism (Cronbach's $\alpha = .66$), education (Cronbach's $\alpha = .72$), and culture (Cronbach's $\alpha = .65$).

Moreover, we asked which reading media the participants use to read books (printed book, e-reader, tablet, smartphone, computer) and if they use a specific reading medium (printed, digitally, or no preference) when reading a specific genre (e.g., classic literature, contemporary literature, non-fiction), in a specific place (e.g., in public places outdoors, on public transportation, in libraries), and at a specific time (e.g., during the daytime, before bed/at night, on vacation). Participants also had the option to answer that they

do not read a specific genre, at a specific time, or in a specific place. Additionally, the participants answered five items about the changes they had noticed since they started reading digitally (e.g., "Since I've been reading e-books, I read books on other topics or from other genres"). These items were only filled out by participants who read both printed books and e-books. An English translation of the entire questionnaire is provided in Appendix 1.

### Data analysis

To investigate demographic differences between digital and print readers and print readers and multi-format users, we conducted a multinomial logistic regression with age, gender, and education as predictors and use of reading media as the dependent variable.

To analyze if there is a difference in the number of minutes read per week, the number of books read per year, and reading motivation between participants who read only printed books, only digital books, and printed and digital books, we used multiple linear regression models with age, gender, educational level, and reading media (dummy coded: printed only, digitally only, both; with the participants reading print as the reference category) as predictors, and number of minutes, number of books, and the motivation subfactors as dependent variables. Moreover, to analyze if the reading medium relates to the choice of genre, reading place, and reading time, we dichotomized the items exploring the preferred reading medium for each genre, place, and time (reads this genre/in this place/at this time vs. does not read this genre/in this place/at this time). We used these dichotomized items as dependent variables in binary logistic regression models with age, gender, educational level, and reading media as predictors. In this part of the analysis, due to very low variance in the dependent variables, we had to exclude the items about reading at home, during the daytime, before bed/at night, on vacation, and if there is a lot of time to read.

Lastly, to explore if there is a dedicated genre, place, or time to read digitally versus in print, we only included answers provided by the participants who read both printed and e-books (multi-format users). We used the same items as before, this time in their original form but without the "I do not read this genre/in this place/at this time" option and employing $X^2$-tests to test if there are significant differences in frequency distribution. If the $X^2$-test showed a significant difference, we also performed pairwise comparisons with a Bonferroni correction. Furthermore, we used the same subsample to analyze if the participants noticed a change in their reading habits, again with $X^2$-tests using only the "I agree" and the "I disagree" answers. The level of significance for all analyses was $p = .05$, except for the Bonferroni corrected pairwise comparisons ($p = .017$).

## Results

### Demographic differences

While age ($X^2(2,\ n = 779) = 17.12,\ p < .001$) and gender ($X^2(2,\ n = 779) = 18.39,\ p < .001$) were both significant predictors of using digital reading media, education

was not ($X^2(2, n = 779) = 4.05, p = .13$). Print readers were more often women than digital readers ($\text{Exp}(B) = 2.78, p < .001$) and multi-format users ($\text{Exp}(B) = 1.57, p < .01$). Furthermore, print readers were older than digital readers ($\text{Exp}(B) = .97, p < .001$). For descriptive information, see Table 1.

## *Differences in reading amount and reading motivation*

The multiple linear regressions showed that digital readers and multi-format users read more than print readers. They read more books per year, and multi-format users also read for more minutes per week than print readers. Print readers, digital readers, and multi-format users also differ in their motivation for reading. Escapism and education were more relevant reading motivations for multi-format users compared to print readers. In contrast, escapism and education were less relevant for digital readers than for print readers. However, there was no difference between multi-format users, digital readers, and print readers in reporting cultural aspects as reading motivation (see Table 2).

## *Differences in preferred genres and reading situations*

Print readers, digital readers, and multi-format users differ in the genres they read. Especially, multi-format users seem to read more diversely than the other two groups. Multi-format users (but not digital readers) read more classic literature, romance/entertainment novels, crime/thriller/horror, and historical novels than print readers. Furthermore, multi-format users and digital readers read significantly more erotic novels and fantasy/science fiction than participants who only read printed books. However, print readers read significantly more non-fiction books than digital readers (but not multi-format users). There was no significant difference between the reading medium groups in reading poetry, contemporary literature, children's/young adults' literature, biographies, guidebooks, and religious scriptures. The results for differences between the reading medium groups in reading situations are similar to the differences in genre. Multi-format users and digital readers seem to read in more diverse situations than print readers. Compared to print readers, multi-format users and digital readers read significantly more when they have only a little time to read and in public spaces, like on public transport, in public places outdoors and indoors, and at the workplace. Additionally, multi-format users read significantly more in libraries than print readers (see Table 3).

However, even though digital readers and multi-format users seem to be more diverse in their reading practice than print readers, the additional digital reading medium does not

**Table 1.** Demographic of print readers, multi-format users, and digital readers.

| Reading medium | Age (mean/*SD*) | Gender (%) | Education |
|---|---|---|---|
| Print readers | 50.06 (15.38) | Women: 60.0 Men: 40.0 | Secondary: 73.0 Tertiary: 27.0 |
| Multi-format users | 48.34 (14.86) | Women: 49.9 Men: 50.1 | Secondary: 70.9 Tertiary: 29.1 |
| Digital readers | 43.31 (14.95) | Women: 38.9 Men: 61.1 | Secondary: 80.6 Tertiary: 19.4 |

**Table 2.** Differences in reading amount and motivation.

| Dependent variable | Independent variable | Corrected $R^2$ | $F(5,773)$ | $p$ | $\beta$ | $p$ |
|---|---|---|---|---|---|---|
| **Reading amount** | | | | | | |
| Books per year | | .05 | 9.31 | <.001 | | |
| | Digital readers | | | | **.17** | **<.001** |
| | Multi-format users | | | | **.22** | **<.001** |
| Minutes per week | | .14 | 25.28 | <.001 | | |
| | Digital readers | | | | .04 | .21 |
| | Multi-format users | | | | **.33** | **<.001** |
| **Reading motivation** | | | | | | |
| Escapism | | .07 | 11.93 | <.001 | | |
| | Digital readers | | | | **−.09** | **.01** |
| | Multi-format users | | | | **.14** | **<.001** |
| Education | | .03 | 5.31 | <.001 | | |
| | Digital readers | | | | **−.08** | **.03** |
| | Multi-format users | | | | **.08** | **.03** |
| Culture | | .02 | 3.66 | <.01 | | |
| | Digital readers | | | | .02 | .56 |
| | Multi-format users | | | | .04 | .27 |

*Note.* Multiple linear regression with age, gender, education level, and reading medium as predictors with separate models for each reading amount measure/motivation facet. The results for age, gender, and education levels are not shown but are available on request. Print readers were used as the baseline category.

seem to be the reason for this diversification, but rather a tool utilized by a specific group of readers with pre-existing differences from print readers. Most participants disagreed with the statement that they read more books in general ($X^2(1, n = 200) = 4.5$, $p = 0.03$) or books from different genres ($X^2(1, n = 243) = 6.92$, $p = .01$) since they also started reading digitally. Furthermore, there was no significant difference in agreement or disagreement with the statement that participants noticed a change in reading at different times during the day and in situations where they only have a little time, since they also read digitally. However, most participants agreed that their places of reading have diversified since they started reading e-books ($X^2(1, n = 277) = 49.42$, $p < .001$).

## *Preferences in reading medium for specific genres and situations*

While it seems that, overall, multi-format users read more diverse genres, in more diverse places, and in more diverse situations than other participants, the digital reading medium is not the preferred reading medium for most genres (see Table 4). Using only the data of the multi-format users, the $X^2$-tests showed a significant preference for printed books when reading classic literature, poetry, children's/young adults' literature, non-fiction books, guidebooks, and religious scriptures. Furthermore, the $X^2$-tests regarding the preferred reading medium for contemporary literature, historical novels, and biographies did show significant differences in the answer distribution, but the category with the highest frequency was "no preference". The pairwise comparisons showed that there was a

**Table 3.** Differences in genre preferences and reading situations.

| Dependent variable | Independent variable | $X^2(5, n = 779)$ | $p$ | Exp($B$) | $p$ |
|---|---|---|---|---|---|
| **Genres** | | | | | |
| Classic literature | | 37.06 | <.001 | | |
| | Digital readers | | | 0.85 | .54 |
| | Multi-format users | | | **1.71** | **<.01** |
| Romance/Entertainment novels | | 100.51 | <.001 | | |
| | Digital readers | | | 1.71 | .07 |
| | Multi-format users | | | **1.68** | **<.01** |
| Erotic novels | | 33.73 | <.001 | | |
| | Digital readers | | | **2.22** | **<.01** |
| | Multi-format users | | | **1.49** | **.01** |
| Crime/Thriller/Horror | | 14.63 | .01 | | |
| | Digital readers | | | 1.79 | .13 |
| | Multi-format users | | | **1.57** | **.02** |
| Fantasy/Science fiction | | 82.13 | <.001 | | |
| | Digital readers | | | **2.2** | **<.01** |
| | Multi-format users | | | **1.66** | **<.01** |
| Historical novels | | 25.32 | .001 | | |
| | Digital readers | | | 1.25 | .43 |
| | Multi-format users | | | **1.56** | **<.01** |
| Non-fiction books (philosophy, politics, etc.) | | 42.15 | <.001 | | |
| | Digital readers | | | **0.48** | **.02** |
| | Multi-format users | | | 1.20 | .38 |
| Contemporary literature | | 21.80 | .001 | | |
| | Digital readers | | | 1.80 | .07 |
| | Multi-format users | | | 1.24 | .22 |
| Guidebooks | | 11.21 | .047 | | |
| | Digital readers | | | 0.72 | .25 |
| | Multi-format users | | | 1.41 | .07 |

*(Continued)*

**Table 3.** (Continued)

| Dependent variable | Independent variable | $X^2(5, n = 779)$ | *p* | Exp(*B*) | *p* |
|---|---|---|---|---|---|
| Children's/Young adults' literature | | 52.13 | <.001 | | |
| | Digital readers | | | 1.38 | .24 |
| | Multi-format users | | | 1.07 | .67 |
| Poetry | | 6.41 | .27 | | |
| Biographies | | 7.95 | .16 | | |
| Religious scriptures | | 9.82 | .08 | | |
| **Situations** | | | | | |
| On public transport (bus, train, etc.) | | 114.39 | <.001 | | |
| | Digital readers | | | **4.68** | **<.001** |
| | Multi-format users | | | **3.49** | **<.001** |
| In public places outdoors (parks, outdoor pools, etc.) | | 91.56 | <.001 | | |
| | Digital readers | | | **2.47** | **.02** |
| | Multi-format users | | | **4.34** | **<.001** |
| In public places indoors (cafes, waiting rooms, etc.) | | 92.56 | <.001 | | |
| | Digital readers | | | **3.38** | **<.001** |
| | Multi-format users | | | **2.93** | **<.001** |
| In libraries | | 47.31 | <.001 | | |
| | Digital readers | | | 1.27 | .40 |
| | Multi-format users | | | **1.39** | **.04** |
| At the workplace (during breaks) | | 101.27 | <.001 | | |
| | Digital readers | | | **1.99** | **.01** |
| | Multi-format users | | | **1.6** | **<.01** |
| If there is little time to read | | 18.93 | <.01 | | |
| | Digital readers | | | **2.14** | **.03** |
| | Multi-format users | | | **1.73** | **<.01** |

*Note.* Binary logistic regression with age, gender, education level, and reading medium as predictors, with separate models for each genre or situation. The results for age, gender, and education level are not shown but are available on request. Print readers were used as the baseline.

**Table 4.** Genre and situation dependent preferences for a specific reading medium.

| | *n* (print/no preference/digital) | $X^2$ | $p^*$ | Pairwise comparison | $X^2$ | $p^{**}$ |
|---|---|---|---|---|---|---|
| **Genres** | | | | | | |
| Classic literature | 248 (130/89/29) | 62.43 | <.001 | | | |
| | | | | digital – print | **64.16** | **<.001** |
| | | | | digital – no preference | **30.51** | **<.001** |
| | | | | print – no preference | **7.68** | **<.01** |
| Poetry | 145 (88/45/12) | 60.10 | <.001 | | | |
| | | | | digital – print | **57.76** | **<.001** |
| | | | | digital – no preference | **19.11** | **<.001** |
| | | | | print – no preference | **13.90** | **<.001** |
| Contemporary literature | 252 (86/117/49) | 27.60 | <.001 | | | |
| | | | | digital – print | **10.14** | **<.01** |
| | | | | digital – no preference | **27.86** | **<.001** |
| | | | | print – no preference | 4.73 | .03 |
| Erotic novels | 141 (29/58/54) | 10.51 | <.01 | | | |
| | | | | digital – print | **7.53** | **<.01** |
| | | | | digital – no preference | 0.14 | .71 |
| | | | | print – no preference | **9.67** | **<.01** |
| Fantasy/ Science fiction | 205 (70/84/51) | 8.03 | .02 | | | |
| | | | | digital – print | 2.98 | .08 |
| | | | | digital – no preference | **8.07** | **<.01** |
| | | | | print – no preference | 1.27 | .26 |
| Historical novels | 246 (100/102/44) | 26.44 | <.001 | | | |
| | | | | digital – print | **21.78** | **<.001** |
| | | | | digital – no preference | **23.04** | **<.001** |
| | | | | print – no preference | 0.02 | .89 |
| Children's/ Young adults' literature | 117 (59/45/13) | 28.51 | <.001 | | | |
| | | | | digital – print | **29.39** | **<.001** |
| | | | | digital – no preference | **17.66** | **<.001** |

*(Continued)*

**Table 4.** (Continued)

| | *n* (print/no preference/digital) | $X^2$ | $p^*$ | Pairwise comparison | $X^2$ | $p^{**}$ |
|---|---|---|---|---|---|---|
| | | | | print – no preference | 1.89 | .17 |
| Non-fiction books (philosophy, politics, etc.) | 286 (149/93/44) | 57.91 | <.001 | | | |
| | | | | digital – print | **57.12** | **<.001** |
| | | | | digital – no preference | **17.53** | **<.001** |
| | | | | print – no preference | **12.96** | **<.001** |
| Biographies | 241 (92/107/42) | 28.84 | <.001 | | | |
| | | | | digital – print | **18.66** | **<.001** |
| | | | | digital – no preference | **28.36** | **<.001** |
| | | | | print – no preference | 1.13 | .29 |
| Guidebooks | 276 (118/106/52) | 26.87 | <.001 | | | |
| | | | | digital – print | **25.62** | **<.001** |
| | | | | digital – no preference | **18.46** | **<.001** |
| | | | | print – no preference | 0.64 | .42 |
| Religious scriptures | 84 (42/30/12) | 16.29 | <.001 | | | |
| | | | | digital – print | **16.67** | **<.001** |
| | | | | digital – no preference | **7.71** | **<.01** |
| | | | | print – no preference | 2.00 | .16 |
| Romance/ Entertainment novels | 225 (60/86/79) | 4.83 | .09 | | | |
| Crime/ Thriller/ Horror | 285 (100/101/84) | 1.92 | .38 | | | |
| **Situations** | | | | | | |
| At home | 337 (130/182/25) | 113.88 | <.001 | | | |
| | | | | digital – print | **71.13** | **<.001** |
| | | | | digital – no preference | **119.08** | **<.001** |
| | | | | print – no preference | **8.67** | **<.01** |
| On public transport (bus, train, etc.) | 274 (35/75/164) | 95.48 | <.001 | | | |
| | | | | digital – print | **83.62** | **<.001** |
| | | | | digital – no preference | **33.14** | **<.001** |
| | | | | print – no preference | **14.55** | **<.001** |

*(Continued)*

**Table 4.** (Continued)

| | *n* (print/no preference/digital) | $X^2$ | $p^*$ | Pairwise comparison | $X^2$ | $p^{**}$ |
|---|---|---|---|---|---|---|
| In public places outdoors | 308 (68/110/130) | 19.51 | <.001 | | | |
| | | | | digital – print | **19.41** | **<.001** |
| | | | | digital – no preference | 1.67 | .20 |
| | | | | print – no preference | **9.91** | **<.01** |
| In public places indoors | 267 (56/101/ 110) | 18.81 | <.001 | | | |
| | | | | digital – print | **17.57** | **<.001** |
| | | | | digital – no preference | 0.38 | .54 |
| | | | | print – no preference | **12.90** | **<.001** |
| In libraries | 208 (152/48/8) | 159.39 | <.001 | | | |
| | | | | digital – print | **129.6** | **<.001** |
| | | | | digital – no preference | **28.57** | **<.001** |
| | | | | print – no preference | **54.08** | **<.001** |
| At the workplace | 163 (40/57/66) | 6.42 | .04 | | | |
| | | | | digital – print | **6.38** | **.012** |
| | | | | digital – no preference | 0.66 | .42 |
| | | | | print – no preference | 2.98 | .08 |
| During the daytime | 322 (87/196/39) | 120.60 | <.001 | | | |
| | | | | digital – print | **18.29** | **<.001** |
| | | | | digital – no preference | **104.89** | **<.001** |
| | | | | print – no preference | **41.98** | **<.001** |
| Before bed/at night | 314 (93/139/82) | 17.47 | <.001 | | | |
| | | | | digital – print | 0.69 | .41 |
| | | | | digital – no preference | **14.70** | **<.001** |
| | | | | print – no preference | **9.12** | **<.01** |
| On vacation | 328 (53/125/150) | 46.40 | <.001 | | | |
| | | | | digital – print | **46.35** | **<.001** |
| | | | | digital – no preference | 2.27 | .13 |
| | | | | print – no preference | **29.12** | **<.001** |

*(Continued)*

**Table 4.** (Continued)

| | *n* (print/no preference/digital) | $X^2$ | $p^*$ | Pairwise comparison | $X^2$ | $p^{**}$ |
|---|---|---|---|---|---|---|
| If I have little time to read | 273 (35/108/130) | 54.35 | <.001 | | | |
| | | | | digital – print | **54.70** | **<.001** |
| | | | | digital – no preference | 2.03 | .15 |
| | | | | print – no preference | **37.27** | **<.001** |
| If I have a lot of time to read | 328 (136/173/19) | 118.21 | <.001 | | | |
| | | | | digital – print | **88.32** | **<.001** |
| | | | | digital – no preference | **123.52** | **<.001** |
| | | | | print – no preference | 4.43 | .04 |

*Note.* $X^2$-tests, *level of significance $p = .05$, **level of significance Bonferroni corrected $p = .017$.

significant difference between the answer categories "reading in print" and "reading digitally", and no significant difference between "reading in print" and "no preference" when reading these genres. This means that print is at least more favored than digital reading devices when reading contemporary literature, historical novels, and biographies. In contrast, the $X^2$-test regarding the preferred reading medium for erotic novels showed a significant difference in answer distribution, the highest frequency being in the "no preference" category. Furthermore, the pairwise comparisons showed that there was a preference for digital reading of erotic novels compared to print, and no significant difference between the "digital reading preference" and "no preference", suggesting that digital reading devices are favored over print. Additionally, the $X^2$-test for the preferred reading medium for fantasy/science fiction showed a significant difference in answer distribution, with the most answers in the "no preference" category. In contrast, there was no significant difference in the direct comparison of print and digital. Therefore, the interpretation is that there was no difference in the reading medium preference for fantasy/science fiction. Furthermore, there was no significant difference in reading medium preference in romance/entertainment novels and crime/thriller/horror.

In contrast, the results showed a very different pattern for the preferred reading medium in specific situations and in specific places (see Table 4). All of the $X^2$-tests were significant. However, reading digitally was the preferred medium for reading on public transport, in a public place outdoors, in a public place indoors, in the workplace, on vacation, and if there is only a little time to read. Only in libraries was print the preferred reading medium. Nevertheless, in four cases, the category with the highest frequency was the "no preference" category. Pairwise comparisons, however, showed that reading in print was favored over reading digitally when reading at home, during the daytime, and if there is a lot of time for reading. The pairwise comparisons of reading printed or digital books before bed/at night were not significant, suggesting that there was no preference for a reading medium.

## Discussion

To explore if digital reading devices and e-books herald "the end of the book", we surveyed actual reading practices and individual differences of readers to determine which factors play a role in adopting digital book reading. Our results show that for leisure reading, the printed book is still the preferred reading medium and is more used than any digital reading device. About 90.8% of the participants still read printed books, either solely or in addition to digital reading media, while only 9.2% of the participants read only digital books. However, there are different aspects of who adopts digital reading and why. Our specific research questions asked how multi-format users, digital readers, and traditional print readers differ and if digital reading devices diversify reading practices. Furthermore, we explored the preferences in genres or situations when it comes to reading in print or digital format. The results clearly showed that:

1. There is a difference between traditional print readers, readers using only digital reading devices, and multi-format users.

2. Digital reading devices diversify the reading practice to a certain degree.
3. There are dedicated reading media for a couple of specific genres and situations.

First of all, multi-format users, digital readers, and print readers differ in their demographic. Digital readers and multi-format users are more often men, while print readers are more often women. These results are in line with a Japanese and a US-American study (Kurata et al., 2017; Zhang & Kudva, 2014), suggesting that this gender gap might not be a specifically national phenomenon. Moreover, print readers are on average older than digital readers. Even though digital reading devices offer some features which could especially meet the needs of elderly people—for example, the light weight of the device or the possibility of enlarging the font size—technophobia could hinder the acceptance of a digital reading device in older people (Hou et al., 2017). Education does not seem to be a crucial factor in the choice of reading medium in Austria. These results contradict the results of Zhang and Kudva (2014) and Faverio and Perrin (2022), who found that in the USA, §higher-educated people (at least college level) are more likely to read digitally than people with a lower education level (high-school level or less). However, due to the Austrian education system, our sample comprised only people with at least a secondary education level, which could explain the lack of variance and that we did not find an effect of education level on adoption of digital book reading.

Furthermore, the reading motivation differs between people reading via different reading media. Compared to print readers, the motivation to read for multi-format users is more often escapism and education, while escapism and education are less often the motivation to read for people reading only digitally. The assumption that print readers, in particular, would value aspects such as participation in cultural life or social recognition more than other readers is not confirmed and does not underlie the reading media decision. In contrast, the results show that multi-format users seem to have a stronger conscious reading motivation than the other two groups, while print and digital readers might not be aware of why they are reading a book. The reason could be that multi-format users have to reflect on which reading medium they use for a specific book and what the use of a specific reading medium implies for the reading experience.

In the USA, the number of books read is the strongest predictor of adoption of digital reading (Zhang & Kudva, 2014). Our results support this claim. Readers exclusively or additionally reading digitally seem to read more than people only reading print. In total, they read more books per year, and participants stating that they read on both reading media also read more minutes per week. However, the participants reported that the amount they read did not change when adopting digital book reading. The results suggest that rather than increasing the number of books read, digital reading devices are more appealing to people who already read a lot. This finding is not surprising, since e-books do not have a physical presence like printed books and therefore do not need to be stored on bookshelves at home and do not take up space in a suitcase. Furthermore, digital reading devices give immediate access to a large number of books, which might not even cost additional money (e.g., digital library access, Amazon Prime reading).

The results regarding readers' genre preferences are similar. While there are differences in genre preferences between multi-format users, digital readers, and print readers, the digital reading devices did not seem to be the trigger for these differences, but again rather attract different people. It turns out that it is mainly multi-format users who read many different genres and thus show the most diverse spectrum of book reading. They stated that their genre selection did not change since they also read digitally, suggesting that they already read diverse genres when reading only in print. Nevertheless, for multi-format users, print is still the preferred reading medium for most genres. However, we were not able to replicate our focus group findings which stated that crime novels, thrillers, and other light fiction were preferably read digitally (Kosch et al., 2021). The survey showed that there is no preference for a reading medium when reading romance and entertainment novels or crime, thriller, and horror. Only erotic novels are rather preferred to be read digitally, most probably because of the greater anonymity when buying (i.e., ordering or downloading) and reading them.

Furthermore, the results are clear and revealing regarding reading places and situations. "Reading on the go is not new", said Balling et al. (2019, p. 198). However, our findings suggest that it is more prevalent than before. The specific affordances of digital reading devices do not only enable reading in more kinds of different locations (Hupfeld et al., 2013), but they actually lead to additional reading on the go. Multi-format users and digital readers read more than print readers when they are not at home or when they only have a little time to read, and multi-format users also choose the digital reading medium in these situations. If the printed book is preferred at home, during the daytime, and when there is enough time, the preferred reading medium for reading on public transport, in a public place, on vacation, and if there is only a little time to read is the digital one. Furthermore, in our sample, digital readers reported reading in more diverse places since they started reading digitally, suggesting that digital reading changed their reading practice.

In summary, the results of the survey show that there are differences between traditional print readers and readers who read digitally exclusively or additionally. Book reading in the digital age has changed primarily in that reading now increasingly takes place on the go and in new situations and places.

However, our study is not without limitations. We conducted the survey online and therefore excluded people who do not use web-enabled devices in the process. Also, under some circumstances, readers' personal preference for a reading medium may be irrelevant, due to the fact, that some books are only published as e-book or only published as printed book. Furthermore, even though most of our results are in line with international studies, some results might be a national phenomenon. The results about the influence of education level on the adoption of digital reading practices especially might be different to other countries due to the Austrian education system.

Of course, we recognize that reading or book cultures differ between countries (e.g., Kurschus, 2014). In particular, fixed book prices are a particularity that may affect medium choices. In general, however, we think our results are largely generalizable because most of them relate to the medium specific affordances, like the transportability

or accessibility of books. Yet cross-national research is needed to further understand the contextual boundaries of our findings. Future research should focus on more interindividual differences, such as education level and digital literacy, but also on general access to technology and, in consequence, how possible differences could be reduced, such as the age or gender gap. Furthermore, listening to audiobooks is a totally different form of book consumption which has not changed much in its mode during the last 50 years but has become more accessible to a wider population due to digitization. Though it seems to be less studied than digital reading, it is an important aspect of consuming literature. Another desideratum is a comprehensive and transdisciplinary theoretical framework which includes specific forms of practice when dealing with printed or digital books. Particular attention would have to be paid to medium-specific practices such as page-turning versus scrolling, distraction, and reading interruptions with multifunctional reading devices, or differences in finishing and rereading books. Such a framework could help to differentiate further and specify more precisely broad surveys regarding digital and print reading.

In conclusion, we can say that today's digital reading of books in leisure time is mainly adopted by those people who read a lot, who read different genres, and who read in various places and situations. This means that experienced book readers especially extend their reading practice with the e-book because it is meeting their demands. The assumption that the e-book will replace the printed book therefore cannot be confirmed, because rather than an either/or, the e-book is a new technological complement to the printed book that is accepted above all by the group of frequent print readers.

## Acknowledgements

We thank Jakob-Moritz Eberl for reviewing our survey.

## Declaration of conflicting interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The results presented here are part of the "Books on Screen" project P 31723-G30, funded by the Austrian Science Fund (FWF).

## ORCID iD


Annika Schwabe https://orcid.org/0000-0002-9274-1417

## Note

1. In the following, we call readers using both printed books and e-books "multi-format users".

## References


Afflerbach, P. P., Cho, B.-Y., Kim, J.-Y., Crassas, M. E., & Doyle, B. (2013). Reading: What else matters besides strategies and skills? *Reading Teacher*, *66*(6), 440–448. https://doi.org/10.1002/TRTR.1146

Andersen, T. R., Kjerkegaard, S., & Stougaard Pedersen, B. (2021). Introduction: Modes of reading. *Poetics Today*, *42*(2), 131–147. https://doi.org/10.1215/03335372-8883164

Ballatore, A., & Natale, S. (2016). e-Readers and the death of the book: Or, new media and the myth of the disappearing medium. *New Media & Society*, *18*(10), 2379–2394. https://doi.org/10.1177/1461444815586984

Balling, G., Begnum, A. C., Kuzmičová, A., & Schilhab, T. (2019). The young read in new places, the older read on new devices: A survey of digital reading practices among librarians and information science students in Denmark. *Participations*, *16*(1), 197–236.

Baron, N. S. (2021). *How we read now: Strategic choices for print, screen, and audio*. Oxford University Press.

Burke, M. (2010). *Literary reading, cognition and emotion: An exploration of the oceanic mind* (1st ed). Routledge. 10.4324/9780203840306 .

Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education*, *105*, 1–13. 10.1016/j.compedu.2016.11.003

Chartier, R. (1995). *Forms and meanings. Texts, performances, and audiences from codex to computer*. University of Pennsylvania Press.

Coiro, J. (2021). Toward a multifaceted heuristic of digital reading to inform assessment, research, practice, and policy. *Reading Research Quarterly*, *56*(1), 9–31. https://doi.org/10.1002/rrq.302

Conradi, K., Jang, B., & McKenna, M. (2014). Motivation terminology in reading research: A conceptual review. *Educational Psychology Review*, *26*(1), 127–164. https://doi.org/10.1007/s10648-013-9245-z

Couldry, N. (2010). Theorising media as practice. In B. Bräuchler, & J. Postill (Eds.), *Theorising media and practice* (pp. 35–54). Berghan Books.

D'Ambra, J., Wilson, C. S., & Akter, S. (2019). Affordance theory and e-books: Evaluating the e-reading experience using netnography. *Personal and Ubiquitous Computing*, *23*(5), 873–892. https://doi.org/10.1007/s00779-017-1086-1

Eco, U., & Carrière, J. C. (2011). *This is not the end of the book. A conversation curated by Jean-Philippe de Tonnac*. Harvill Secker.

Faverio, M., & Perrin, A. (2022). *Three-in-ten Americans now read e-books*. https://www.pewresearch.org/fact-tank/2022/01/06/three-in-ten-americans-now-read-e-books/

Hauk, N., Hüffmeier, J., & Krumm, S. (2018). Ready to be a silver surfer? A meta-analysis on the relationship between chronological age and technology acceptance. *Computers in Human Behavior*, *84*, 304–319. https://doi.org/10.1016/j.chb.2018.01.020

Hou, J., Wu, Y., & Harrell, E. (2017). Reading on paper and screen among senior adults: Cognitive map and technophobia. *Frontiers in Psychology*, *8*, 2225. https://doi.org/10.3389/fpsyg.2017.02225

Hupfeld, A., Sellen, A., O'Hara, K., & Rodden, T. (2013). Leisure-based reading and the place of e-books in everyday life. In P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, & M. Winckler (Eds.), *Human-computer interaction – INTERACT 2013* (pp. 1–18). Springer. https://doi.org/10.1007/978- 3-642-40480-1_1

Kosch, L., Stocker, G., Schwabe, A., & Boomgaarden, H. G. (2021). Reading fiction with an e-book or in print: Purposes, pragmatics and practices. A focus group study. *Scientific Study of Literature*, *11*(2), 196–222. https://doi.org/10.1075/ssol.21012.kos

Kurata, K., Ishita, E., Miyata, Y., & Minami, Y. (2017). Print or digital? Reading behavior and preferences in Japan. *Journal of the Association for Information Science and Technology*, *68*(4), 884–894. https://doi.org/10.1002/asi.23712

Kurschus, S. (2014). *European book cultures: Diversity as a challenge*. Springer.

Kuzmičová, A., Schilhab, T., & Burke, M. (2020). m-Reading: Fiction reading from mobile phones. *Convergence*, *26*(2), 333–349. https://doi.org/10.1177/1354856518770987

Lesage, F., & Natale, S. (2019). Rethinking the distinctions between old and new media: Introduction. *Convergence*, *25*(4), 575–589. https://doi.org/10.1177/1354856519863364

Mangen, A. (2008). Hypertext fiction reading: Haptics and immersion. *Journal of Research in Reading*, *31*(4), 404–419. https://doi.org/10.1111/j.1467-9817.2008.00380.x

Reckwitz, A. (2002). Toward a theory of social practices. *European Journal of Social Theory*, *5*(2), 243–263. https://doi.org/10.1177/13684310222225432

Schön, E. (1999). Geschichte des lesens. In B. Franzmann, K. Hasemann, D. Löffler, & E. Schön (Eds.), *Handbuch lesen* (pp. 1–85). K. G. Saur.

Siddiq, F., & Scherer, R. (2019). Is there a gender gap? A meta-analysis of the gender differences in students' ICT literacy. *Educational Research Review*, *27*, 205–217. https://doi.org/10.1016/j.edurev.2019.03.007

Taipale, S., Oinas, T., & Karhinen, J. (2021). Heterogeneity of traditional and digital media use among older adults: A six-country comparison. *Technology in Society*, *66*, 101642. https://doi.org/10.1016/j.techsoc.2021.101642

Thorson, E., Shoenberger, H., Karaliova, T., Kim, E., & Fidler, R. (2015). News use of mobile media: A contingency model. *Mobile Media & Communication*, *3*(2), 160–178. https://doi.org/10.1177/2050157914557692

Thumala Olave, M. A. (2020). Book love. A cultural sociological interpretation of the attachment to books. *Poetics*, *81*(101440), 1–11. https://doi.org/10.1016/j.poetic.2020.101440

Wolf, M. (2018). *Reader, come home: The reading brain in a digital world*. Harper.

Zhang, Y., & Kudva, S. (2014). E-books versus print books: Readers' choices and preferences across contexts. *Journal of the Association for Information Science and Technology*, *65*(8), 1695–1706. https://doi.org/10.1002/asi.23076

## Author biographies

Annika Schwabe studied Psychology at the University of Vienna with a focus on Research Methods and Statistics and studied additionally International Development Studies. She also completed the postgraduate training in Emergency Psychology and Psychological Crisis Management at the Sigmund Freud Private University and is a lecturer for Statistics at the Faculty of Psychology of the University of Vienna. Since June 2019, she has been working on her dissertation in Communication Sciences, dealing with the cognitive, social, and emotional aspects of the digitization of fiction reading.

Lukas Kosch studied German Literature and History at the University of Vienna and is doing research on post-war literature and philosophy. He taught German and created teaching materials for the Austrian Mediathek (project "Interviews als Quelle"). In his doctoral thesis he is searching for the localization und function of the reader in literary theory.

Hajo G. Boomgaarden is Professor of Empirical Social Science Methods with a Focus on Text Analysis at the Department of Communication, and currently Dean of the Faculty of Social Sciences at the University of Vienna. Previously, he has worked as an Associate Professor for

Political Communication at the Amsterdam School of Communication Research and the Department of Communication at the University of Amsterdam. Currently, he is principle investigator of the Media Side project of the Austrian National Election Study and in the H2020 projects REMINDER and MIRROR. He serves as deputy scientific director of the Austrian Social Science Data Archive, deputy director of the Vienna Center for Electoral Research and Scientific Board member of the European Social Survey. He is an Associate Editor of the *Journal of Communication*. His research interests focus on content analyses of media portrayals of politics, on media effects on political attitudes and behaviors, on the effects of media on cognitive processes and on methodological advances of content analysis techniques. He has (co-)authored more than 80 international journal articles and numerous book chapters on issues such as media and European integration, media election campaign and issue coverage, media effects on economic perceptions, immigration attitudes and extreme-right voting and on framing effects.

Günther Stocker is a university professor for German Literature at the University of Vienna; studied German Literature and Communication Studies at the Universities of Salzburg and Zurich, 1996 PhD. from the University of Salzburg; Habilitation at the University of Vienna (2007); lecturer at the Universities of Rome III, Cassino, and Salzburg; APART-Scholarship from the Austrian Academy of Sciences; main research areas: postwar- and Cold War literature, Austrian literature, reading research.

## Appendix 1

### *Questionnaire*

Filter question: Do you read books (or e-books) in your spare time? (*Yes/No*)

Age
Gender (Female, Male, Non-binary, I don't want to disclose my gender)
Highest level of education (Secondary education, Tertiary education)

When you read books in your free time, how important are the following aspects to you? (1 = *Very unimportant*, 2 = *Unimportant*, 3 = *Important*, 4 = *Very important*)

- Fun and entertainment (*Escapism*)
- Knowledge acquisition and information gathering (*Education*)
- Professional benefit (*Education*)
- Personal development (*Education*)
- Immersion in other worlds (*Escapism*)
- Examination of language and texts (*Culture*)
- Participation in cultural life (*Culture*)
- Social recognition (*Culture*)
- Relaxation and deceleration (*Escapism*)

Which reading medium do you use to read books? Choose as many as you like.
(*Printed books / e-Reader / Smartphone / Tablet / Computer or laptop*)

How many minutes do you spend reading printed books on average in a week? (only shown when print reading was selected before)

How many books do you read in print on average per year? (only shown when a print reading was selected before)

How many minutes do you spend reading e-books on average in a week? (only shown when a digital reading device was selected before)

How many e-books do you read on average per year? (only shown when a digital reading device was selected before)

Please indicate to what extent you agree with the statements (*I disagree / I agree / Neutral*; only shown when a digital reading device and printed books were selected before).
Since I've been reading e-books, …

- … I read more books.
- … I read books on other topics or from other genres.
- … I read in other places.
- … I read at different times of the day.
- … I also read when I have little time.

How do you prefer to read the following genres? (*Printed, No preference, Digitally, I don't read this genre*)

- Classic literature
- Poetry
- Contemporary literature
- Romance / Entertainment novels
- Erotic novels
- Crime / Thriller / Horror
- Fantasy / Science fiction
- Historical novels
- Children's / Young adults' literature
- Non-fiction books (philosophy, politics, etc.)
- Biographies
- Guidebooks
- Religious scripture

How do you prefer to read in the following places? (Printed, No preference, Digitally, I don't read in this place)

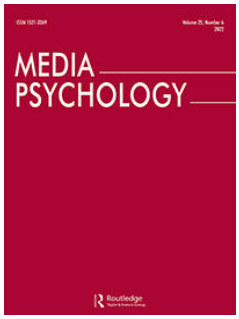
- At home
- On public transport (bus, train, etc.)
- In public places outdoors (parks, outdoor pools, etc.)
- In public places indoors (cafes, waiting rooms, etc.)
- In libraries
- In the workplace (during breaks)

How do you prefer to read at the following times? (*Printed, No preference, Digitally, I don't read at this time*)

- During the daytime
- Before bed / at night
- On vacation
- If I have little time to read
- If I have a lot of time to read

## 4.2. Study 2: No Negative Effects of Reading on Screen on Comprehension of Narrative Texts Compared to Print: A Meta-Analysis.

Schwabe, A., Lind, F., Kosch, L., & Boomgaarden, H. G. (2022). No negative effects of reading on screen on comprehension of narrative texts compared to print: A meta-analysis. *Media Psychology*, *25*(6), 779–796. https://doi.org/10.1080/15213269.2022.2070216



Media Psychology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hmep20

# No Negative Effects of Reading on Screen on Comprehension of Narrative Texts Compared to Print: A Meta-analysis

Annika Schwabe, Fabienne Lind, Lukas Kosch & Hajo G. Boomgaarden

**To cite this article:** Annika Schwabe, Fabienne Lind, Lukas Kosch & Hajo G. Boomgaarden (2022) No Negative Effects of Reading on Screen on Comprehension of Narrative Texts Compared to Print: A Meta-analysis, Media Psychology, 25:6, 779-796, DOI: 10.1080/15213269.2022.2070216

**To link to this article:** https://doi.org/10.1080/15213269.2022.2070216

MEDIA PSYCHOLOGY
2022, VOL. 25, NO. 6, 779–796
https://doi.org/10.1080/15213269.2022.2070216

Routledge
Taylor & Francis Group



# No Negative Effects of Reading on Screen on Comprehension of Narrative Texts Compared to Print: A Meta-analysis

Annika Schwabe [a], Fabienne Lind [b], Lukas Kosch [c], and Hajo G. Boomgaarden [b]

[a]Department of Communication, Department of German Studies, University of Vienna, Wien, Austria; [b]Department of Communication, University of Vienna, Wien, Austria; [c]Department of German Studies, University of Vienna, Wien, Austria

**ABSTRACT**

While some argue digital reading media may impair text comprehension, the empirical literature is ambiguous, in particular when it comes to the reading of narrative texts. Therefore, a comprehensive and systematic meta-analysis of studies exploring the effect of screen reading media on reading comprehension of narrative texts was conducted ($k = 32$, $N = 2239$). Multimedia and interactive functions in general, the type of multimedia and interactive functions, the change in effect over time, and the type of digital reading device (computer, e-reader, and tablet) were explored as moderating variables. In general, the analyses did not reveal a significant impact of the reading medium (screen vs. paper) on the reading comprehension of a narrative text. Moreover, there does not seem to be a difference over time and between different types of digital reading devices. Also, the analysis of the subsample of studies using plain digital text without any additional functions in comparison to print showed no significant differences. In contrast, multimedia and interactive functions of digital texts affect reading comprehension positively, regardless of the type of additional function. In conclusion, the results do not suggest a negative effect of digital reading media on reading comprehension when reading narrative texts.

Reading is a vital skill, important for many aspects of our daily lives. Apart from educational settings, reading narrative texts for leisure is a key component of literacy. It is associated with better reading comprehension and uniquely contributes to a higher-level comprehension skill of inference-making (Duncan, McGeown, Griffiths, Stothard & Dobai, 2016; Torppa et al., 2020). Since leisure book reading is a major predictor of reading performance (Torppa, Eklund, Sulkunen, Niemi & Ahonen, 2018), observing changes in leisure reading behavior is essential. One of the main changes in recent years is the emergence and widespread use of digital texts in leisure time reading, partially replacing print reading. Even though the printed book is still a vital reading medium, the popularity of digital reading media is high (Khatri, 2020; Loh & Sun, 2019). Critics of digital reading argue that a digital reading device might disturb reading performance, in particular comprehension processes (e.g., Baron, 2015; Wolf, 2018).

Yet, the empirical literature presents inconclusive results. The dependency of reading comprehension on digital versus non-digital (i.e., print) reading media was the subject of a few meta-analyses in recent years (Clinton, 2019; Delgado, Vargas, Ackerman & Salmerón, 2018; Imel, 2018; Kong, Seo & Zhai, 2018). These generally claim that reading comprehension would be negatively affected by digital reading media. However, these prior meta-analyses mainly focus on academic reading and are not comprehensive concerning studies using narrative texts as stimuli, the most common text genre for

**CONTACT** Annika Schwabe annika.schwabe@univie.ac.at Department of Communication, Department of German Studies, University of Vienna, Universitätsring 1, Wien, Vienna 1010

leisure reading. Accordingly, Kong, Seo and Zhai (2018) and Imel (2018) did not differentiate between text genres in their analyses. Clinton (2019) and Delgado, Vargas, Ackerman and Salmerón (2018) did separate their analyses by genre but only included studies with specific years of publication. Therefore, we argue that an additional meta-analysis of the existing literature is needed to come to a more comprehensive and thorough understanding of the effect of digital versus non-digital reading media on reading comprehension.

In our study, we explored the effect of digital reading exclusively for the reading of narrative texts and did so based on a meta-analysis of all relevant studies published over the past four decades. In addition to the main effects of reading medium on reading comprehension, which is at the heart of our analysis, we specify three factors that are argued to condition medium effects: multimedia and interactive functions, the differences of the effects over time, and different digital reading devices. Investigating the impact of these three factors provides more insights into the nuances of the reading medium's effect on reading comprehension. The results of our analysis help to further understand general reading processes and the reading medium's impact on leisure reading. Due to the progressing digitization of teaching materials, the results are especially important for educational researchers as well as practitioners.

## Theoretical Background

### *Reading Narrative Texts on Screen*

Even though narrative texts are an essential component in educational settings, they are primarily used for entertainment purposes (Martin-Chang, Kozak, Levesque, Calarco & Mar, 2021). Thus, studies interested in the effects of reading narrative texts often focus on the reception of narratives, and emotional and affective aspects. Comprehension, by contrast, is more commonly considered in studies looking at the effects of reading expository texts (e.g., Hebert, Bohaty, Nelson & Brown, 2016). However, as reading is an activity with the goal of decoding a text, reading comprehension is arguably the most crucial factor in narrative reading as well, and not only for expository texts (Oakhill, Cain & Elbro, 2015). Thus, as used in this article, reading comprehension describes a process of forming a suitable mental model based on understanding written words and sentences. This process includes literal as well as inferential comprehension of a text (Oakhill, Cain & Elbro, 2015).

Regardless of the respective facets of comprehension, four previously conducted meta-analyses consistently showed inferiority in reading comprehension of digital reading media compared to print (Clinton, 2019; Delgado, Vargas, Ackerman & Salmerón, 2018; Imel, 2018; Kong, Seo & Zhai, 2018). Digital reading media might trigger different reading processes than a printed book. More superficial reading strategies, like skimming and scanning, might be applied when reading books digitally rather than the deeper processing strategy learned for and by reading printed books (Baron, 2015; Wolf, 2018). However, the text genre is likely to condition this effect. In general, reading comprehension of narrative texts is better than reading comprehension of an expository text (Mar, Li, Nguyen & Ta, 2021). On the textual level, they consist of more connectives and present more temporal cohesion, both of which benefit reading comprehension (Graesser & McNamara, 2011). But also, when texts are framed as narrative texts, they are processed more slowly than texts framed as expository texts, which results in better memory for verbatim information and a better generation of inferences (Clinton et al., 2020; Zwaan, 1993). These findings can be explained by the higher emotional valence of a narrative text, which leads to more reading engagement and, therefore, to deeper processing and greater reading comprehension (Hamedi, Pishghadam & Fadardi, 2020). Thus, the deeper processing of the text might balance out the negative effect of a digital reading medium. Indeed, studies that also used text genre as a moderating variable in their meta-analysis painted a different picture of the impact of the reading medium on reading comprehension. Both Clinton (2019) and Delgado, Vargas, Ackerman and Salmerón (2018) showed a stable effect of the reading medium on reading expository texts.

However, neither of them replicated this finding with studies using narrative texts only. In their meta-analyses, they each used only seven samples, possibly limiting statistical power. Therefore, for our study that focuses on narrative texts only, the research question reads:

RQ1: *Does reading comprehension differ when the same narrative text is read on a screen versus in print?*

## Digital Reading Affordances

An explanation for the growing popularity of digital reading could be that the device-specific affordances of digital reading media are more diverse than those of a printed book. The "conceptual definition of affordances – broadly described as possibilities for action – is the 'multifaceted relational structure' [. . .] between an object/technology and the user that enables or constrains potential behavioral outcomes in a particular context" (Evans, Pearce, Vitak & Treem, 2017, p. 36). Different types of screen devices, but also different types of e-books may offer very different "possibilities for action," which, in turn, may affect reading comprehension.

Reading media differ primarily due to their different sensorimotor and cognitive affordances, which entails different forms of interaction and attention (Mangen, 2016; Schilhab, Balling & Kuzmicova, 2018). Multimedia devices like computers, tablets, and smartphones can be used for a broad range of different activities, while printed books and e-readers are designed simply for the purpose of reading. Digital reading devices offer specific functionalities, such as almost unlimited access to literature anywhere anytime or the possibility to enlarge the font size or to change the background light to the readers' own preference. Further, they may present interactive functions such as hyperlinks to further information and dictionaries. Smartphones, tablets, and computers additionally offer multimedia additions but also functions distracting from the reading flow, like an internet browser, messengers, and other apps (D'Ambra, Wilson & Akter, 2019).

To explore the effect of digital reading media-specific affordances, we below elaborate on the relevance of three moderator variables for our analysis: multimedia and interactive functions, the differences of the effects over time, and different digital reading devices.

### Digital functions: Multimedia and interactive reading

The affordances of digital reading media offer the possibility to include interactive and/or multimedia functions. It has been shown in other areas that such functions may contribute to learning (e.g., Greussing, Kessler & Boomgaarden, 2020). However, to our knowledge, prior research has not systematically quantified a summary effect of the impact of multimedia and interactive functions on reading comprehension in the area of reading narrative texts. Most of the meta-analyses mentioned above primarily included studies in which participants were presented the same plain text, once in print and once digitally on a screen. They, therefore, did not take media-specific affordances into account, which arguably are an important facet of digital reading media. For the present study, we deliberately decided to also include studies where the digital text is presented with additional functions. These additional functions include interactive and multimedia functions, like built-in dictionaries, pronunciation support, music, or animations. While we are well aware that interactive and multimedia functions are not identical and may elicit different responses (e.g., Takacs, Swart & Bus, 2015), for the purpose of this study, we needed to construct umbrella conceptualizations of affordances and therefore consider them in one variable. However, we differentiate between *entertaining story-supporting functions*, like animations, music, and sounds, and *non-entertaining comprehension-supporting functions*, like dictionaries and pronunciation support.

Digital reading was supplemented with additional functions already at an early stage. In the late 1980s, the first digital storybooks for children were developed. These did not only feature plain text shown on a screen but also multimedia functions, like word-by-word reading, as well as interactive functions, like a variety of small games (Chomsky, 1990). Over the years, the functions of computer-

supported storybooks were expanded to include multimedia options to, e.g., watch animations and listen to background music and sounds. Furthermore, readers can use interactive functions, like a virtual tutor reacting with feedback to their actions or use an advanced dictionary function (Bus, Takacs & Kegel, 2015).

However, it is not clear yet how those functions affect reading comprehension of a narrative text. Cognitive load theory suggests that working the memory can only process a certain amount of information, and splitting attention between different modes of information presentation could hinder comprehension (Chandler & Sweller, 1991). In favor of this theory, Lange (2019) reported that their participants' immersion was disturbed by those additional functions. However, Plass, Heidig, Hayward, Homer, and Um (2014) found that positive emotions induced by a multimedia design fostered comprehension of informational material. Furthermore, Xu and Sundar (2016) described that the interactivity of a website affects the information processing of the interactive content positively and the information processing of the non-interactive content negatively.

Previous studies have suggested that it may not be the presence or absence of additional functions that makes the difference, but the type of the functions. In children, age 1–8 years old, print is outperformed by digital reading when the additional functions are content-related (Furenes, Kucirkova & Bus, 2021). Further multimedia functions benefit reading comprehension in pre-school and primary school, while interactive functions seem to distract (Takacs, Swart & Bus, 2015). We contrasted studies using e-books offering entertaining functions additional to non-entertaining functions with studies that provided books with only non-entertaining comprehension supporting functions. Accordingly, our second research question is focused on the general effect of additional digital functions and the third on the effect of a specific type of digital functions:

RQ2: *Does reading comprehension differ between reading narrative multimedia/ interactive books and reading the same text in a printed version?*

RQ3: *Do different types of additional digital functions affect the reading comprehension differently compared to print when reading a narrative text?*

### *Changes in reading comprehension on screen over the last decades*

Over the last 40 years, the quality of digital reading media steadily increased with higher screen resolutions and faster information processing. Also, the use of digital reading media drastically increased while the novelty of the devices' affordances decreased. One might think that with the advantage of enhancing technologies, more routine use of technology, and more digital experience, the print superiority in reading comprehension may decrease (Chen, Cheng, Chang, Zheng & Huang, 2014). In contrast, Kaufman and Flanagan (2016) argued that the experience with technology gained over the years could have a negative effect on comprehension. Learned habits, like skimming and quick scanning when reading digital, and therefore screen familiarity might lead to shallower reading. People might not mobilize the cognitive resources needed to sufficiently comprehend a text because they perceive a digital reading device as a platform for more superficial reading, like for checking e-mails and messages, and for reading shorter texts like news (Ackerman & Goldsmith, 2011).

No meta-analysis has, to our knowledge, studied the effect of reading on screen on especially narrative texts over a longer period of time. Still, by reviewing other meta-analyses on related topics, there is one that finds no effect (Kong, Seo & Zhai, 2018: investigated period 2001–2016, comparing studies published before and after 2013) and two that find a widening gap between print and digital reading (Imel, 2018: investigated period 1980–2016; Delgado, Vargas, Ackerman & Salmerón, 2018: investigated period 2000–2017). Following the two latter studies with a more similar range of publication years considered (i.e., Imel, 2018) as ours (i.e., 1982–2021) or a larger sample size (i.e., Delgado, Vargas, Ackerman & Salmerón, 2018), we explore whether the publication date has an effect. Thus, our fourth research question is:

RQ4: *Did the reading medium's effect on comprehension when reading a narrative text change over time?*

### *Different digital reading devices*

In addition to the computer, within the last two decades, new reading devices, like tablets, e-readers, and smartphones, have been introduced as digital reading media. It is commonly acknowledged that the affordances of a particular device condition media effects (e.g., Fox & McEwan, 2017). In line with the shallow reading hypothesis (e.g., Kaufman & Flanagan, 2016), different reading devices could vary in their effect on reading comprehension due to different affordances. While computers, tablets, and smartphones offer a range of functions, e.g., browsing the internet or messaging, e-readers are primarily designed as a digital version of a printed book, providing fewer distractions from the text (Sage, Piazzini, Downey & Masilela, 2020). Furthermore, the static file types like PDF (usually used on computers) affect reading comprehension differently than dynamic file types like EPUB (usually used on e-readers and in reading applications for smartphones and tablets). For example, the reading speed is higher when texts are read as EPUB compared to PDF (Zeng, Bai, Xu & He, 2016).

Primary studies on digital versus print reading and reading comprehension did test the effects of various types of digital reading devices. However, usually, only one screen type is included per study, and a comparative angle toward medium differences is rarely explored (exceptions are: Çınar, Doğan & Seferoğlu, 2019; Margolin, Driscoll, Toland & Kegler, 2013; Subrahmanyam et al., 2013). In their meta-analysis, Delgado, Vargas, Ackerman, and Salmerón (2018) did not find a significant difference between hand-held reading devices (tablet and e-reader) and computers in their effect on reading comprehension. However, in their analysis, they summarized the effects of reading on a tablet with reading on an e-reader. We, in contrast, decided to look at the two screen types separately because a tablet's affordances with its multimedia purposes might be more similar to a computer's affordances than an e-reader's. Accordingly, the research question is:

RQ5: Do different digital reading devices differ in their effect on reading comprehension compared to print when reading a narrative text?

## Methods

### *Literature Search*

We collected the sample of studies used in the meta-analyses in three phases. First, we conducted an extensive literature search in the databases Scopus, PsycInfo, and Web of Science using the search strings "digital AND read*," "screen AND read*," and "digital AND print" and the keywords "eread*," "kindle," "tolino," and "nook." Second, to identify studies not detected by the database search, we performed a backward reference search by browsing the reference lists of the identified articles for further studies and a forward search by browsing the list of articles citing the identified articles in Google Scholar. Third, to find further eligible studies, we used the reference lists of the published meta-analyses by Delgado et al. (2018) and Clinton (2019). We also included gray literature, such as conference papers, dissertations, and master theses. The last search was conducted in February 2021. In line with reporting standards (Liberati et al., 2009), the complete sample selection process is shown in the PRISMA flow diagram (Figure 1).

### *Inclusion/exclusion Criteria*

We included studies that reported a comparison of reading comprehension between reading the printed version and any digital version of the same text (between-participant or within-participant). Thus, we did not include effect sizes for comparisons of different screen types or different digital

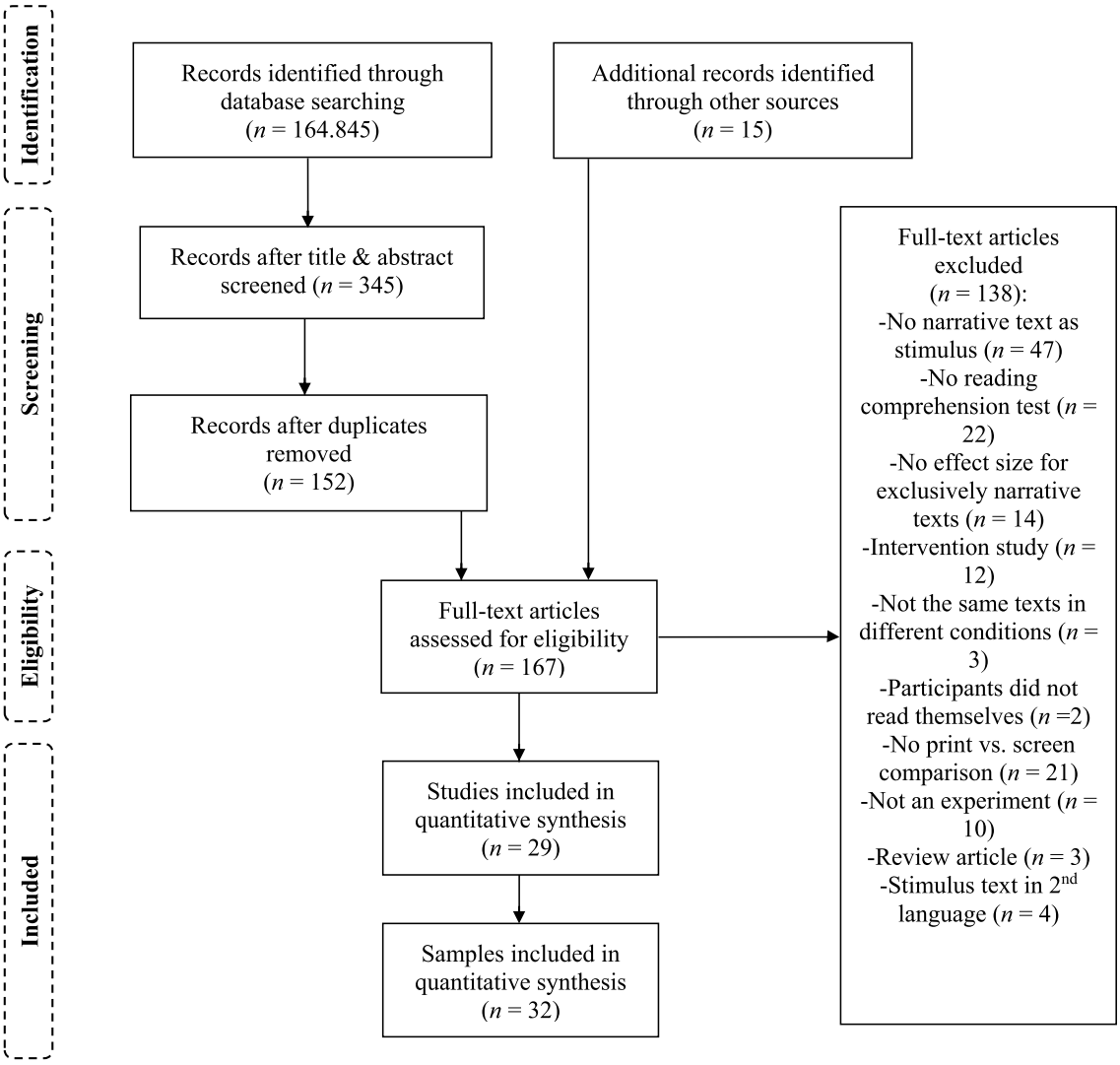



**Figure 1.** Flow digram of study inclusion.

reading modes and also excluded intervention studies in which either the participants in different conditions did not read the same texts or participants did not answer comprehension questions to a specific stimulus text. Furthermore, the stimulus material must have included at least one narrative text with an individual effect size for this text or text type. We therefore excluded studies using exclusively expository texts as stimulus. We also excluded effect sizes describing the relationship of the reading medium and reading comprehension of expository texts only or a combination of narrative and expository texts. Additionally, studies were excluded when the stimulus text featured the possibility of reader interference in the story, such as visual novels or text-based computer games. In contrast to the meta-analysis by Furenes, Kucirkova and Bus (2021), we only included studies where the participants read most of the text themselves and did not primarily listen to a second person or application reading the text aloud. Therefore, participants' education level must have been at least the first grade of primary school, and participants had to have at least enough reading skills to read the stimulus material on their own. However, we did include studies where children listened to parts (but not all) of books with multimedia functions (e.g., when the spoken language is read aloud, or single words have a pronunciation support option).

To ensure at least some comparability in this heterogeneous sample, we included only studies using stimulus texts presented in the first language of most of the participants. We excluded qualitative research and case studies and set the minimum of the sample size to ten participants per experiment.

## Coding Procedure

The data extraction of all the articles was done by two of the authors, resulting in independent observations for each article. Differences in coding were discussed until a consensus of 100% was reached. We coded the following key variables: study authors, publication year, additional multimedia/interactive functions (yes/no), type of additional functions (entertaining (e.g., animations, music) and non-entertaining functions (e.g., dictionaries, pronunciation support)/only non-entertaining comprehension supporting functions), screen type (computer, tablet, e-reader, smartphone, television), study design (between-participant, within-participant), type of publication (peer-reviewed publication, gray literature), sample size, sample age (1st–12th grade, university students, other adults; coded as *primary school* (1st–4th grade), *secondary school* (5th–12th grade), and *adults* (university students and other adults) and relevant effect sizes; and additionally, country in which the study was conducted, gender ratio, type of comprehension test (multiple choice, open questions, retelling; inferential questions, detailed questions, spatiotemporal questions), and the titel of stimulus text (when no additional information was provided, it was coded as *narrative text*).

## Sample

In total, 32 independent samples, published in 19 articles and 10 gray literature items, were included. The total sample size was $N = 2239$ with a mean of 69.97 ($SD = 54.74$), ranging from $N = 19$ individual participants to $N = 284$. In total, 66 effect sizes for the difference in reading comprehension between reading on screen and on paper were extracted. Even though we did not limit our search to English articles, the final sample consisted of articles written in English only. The data came from eleven countries, with 17 articles from North America, seven articles from Asia, and five articles from Europe. We included studies published between 1982 and 2021. When the relevant effect sizes were not reported in the published text or the supplemental material, authors were contacted to add the missing information. For further sample characteristics, see Table 1. The sample references are provided in the supplemental material.

## Statistical Analyses

We converted the collected effect sizes into Cohen's $d$ (see supplementary material) using Comprehensive Meta-Analysis software Version 3 (Borenstein, Hedges, Higgins & Rothstein, 2014). A positive $d$-value describes a positive effect of the digital reading medium on comprehension compared to print. When more than two effect sizes were reported, e.g., effect sizes for more than one stimulus text, different types of questions, or different types of screens, all effect sizes were converted and used in the analysis.

For the analysis, we used the R package *robumeta* (Fisher, Tipton & Zhipeng, 2017). Because most of the studies reported more than one effect size for the comparison of reading on screen and on paper, we conducted a robust variance estimation (RVE). With RVE, it is possible to include statistically dependent effect sizes in one meta-analysis without the loss of information and without the need to know the underlying covariance structure of the used effect sizes (Tanner-Smith, Tipton & Polanin, 2016). For all meta-analyses, we modeled meta-regressions with correlated effects and with small sample size corrections. We used $\rho = .8$ as an estimation for the correlation of effect sizes within a sample, which is the default option of robumeta (alternative settings did not substantially alter the results). We conducted a meta-regression of the whole sample and five sub-samples (studies with and without additional functions and studies using a computer, e-reader, or tablet as digital reading medium) to analyze the effect of the different reading devices on reading comprehension. To examine heterogeneity, $I^2$ and $\tau^2$ are reported. A positive mean effect size describes a better comprehension when the stimulus text is read on screen than in print.

**Table 1.** Sample characteristics.

| Study | Type of publication | Study design | Study location | Sample size | Age group | % women/ girls | Digital reading device | Interactive and/ or multimedia functions | Type of addtional function | Stimulus text | Type of comprehension test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cavalli et al. (2019), sample 1 | Journal | Within | France | 30 | University | 60 | E-reader | No | - | Dernière journée (Last day); Bats-toi, ma belle (Girl, don't give up!) | Open questions (OQ) & sorting: literal & inferential & spatiotemporal |
| Cavalli et al. (2019), sample 2 | Journal | Within | France | 30 | University | 60 | E-reader | No | - | Dernière journée (Last day); Bats-toi, ma belle (Girl, don't give up!) | OQ & sorting: literal & inferential & spatiotemporal |
| Chen and Chen (2014) | Journal | Between | Taiwan | 53 | 5th grade | 49.06 | Computer | Yes | Non-entertaining only | An unbelievable night; Pufflings | Multiple choice questions (MC), OQ, fill-in-the-blanks: literal & inferential |
| Çınar et al. (2019), sample 1 | Journal | Between | Turkey | 63 | 5th–8th grade | 100 | Smartphone, tablet, computer | No | - | Narrative text | MC: inferential & literal |
| Çınar et al.(2019), sample 2 | Journal | Between | Turkey | 64 | 5th–8th grade | 0 | Smartphone, tablet, computer | No | - | Narrative text | MC: inferential & literal |
| Doty et al. (2001) | Journal | Between | United States of America (USA) | 39 | 2nd grade | 51.28 | Computer | Yes | Non-entertaining only | Thomas' Snowsuit | OQ & Retelling: literal & inferential |
| Duran and Alevli (2014) | Journal | Within | Turkey | 74 | 8th grade | Not mentioned | Computer | No | - | Narrative text | OQ: literal & inferential |
| Ertem (2009) | Dissertation | Between | USA | 51 | 4th grade | 62.3 | Computer | Yes | Entertaining and non-entertaining | Sheila Rae, the Brave; Arthur's Teacher Trouble | MC & retelling |
| Grace (2011) | Master thesis | Within/ between | USA | 19 | 3rd grade | Not mentioned | Tablet | Yes | Non-entertaining only | Ramona Quimby: Age 8 | OQ: literal & inferential |

(*Continued*)

**Table 1.** (Continued).

| Study | Type of publication | Study design | Study location | Sample size | Age group | % women/ girls | Digital reading device | Interactive and/ or multimedia functions | Type of addtional function | Stimulus text | Type of comprehension test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Greenlee-Moore and Smith (1994) | Conference paper | Between | USA | 31 | 4th grade | Not mentioned | Computer | Yes | Entertaining and non-entertaining | Thomas' Snowsuit; The Paper Bag Princess; Mud Puddle; Heather Hits her First Home Run; Moving Gives Me A Stomachache; The Tale of Benjamin Bunny; The Tale of Peter Rabbit | MC: literal, vocabulary, inferential |
| Grimshaw et al. (2007), study 1 | Journal | Between | United Kingdom | 51 | Primary school | Not mentioned | Computer | Yes | Entertaining and non-entertaining | The Magicians of Caprona | MC & OQ: literal & inferential |
| Grimshaw et al. (2007), study 2 | Journal | Between | United Kingdom | 55 | Primary school | Not mentioned | Computer | No | - | The Little Prince | MC & OQ: literal & inferential |
| Halamish and Elbaz (2020) | Journal | Within | Israel | 38 | 5th grade | 57.89 | Computer | No | - | Narrative texts | MC: literal & inferential |
| Hermena et al. (2017) | Journal | Within | United Arab Emirates | 24 | University | Not mentioned | Tablet | No | - | Masafat | MC: literal |
| Hsiao and Chen (2015) | Journal | Between | Taiwan | 60 | 3rd grade | 36.67 | E-reader | Yes | Entertaining and non-entertaining | Missing Grandmother | MC |
| Jeong (2012) | Journal | Within | South Korea | 56 | 10–12 years old | 48.21 | Computer | No | - | Narrative texts | MC |
| Kaufman and Flanagan (2016) | Conference paper | Between | USA | 81 | Adults | 58,02 | Computer | No | - | Narrative texts | MC: literal & inferential |
| Mangen et al. (2019) | Journal | Between | France | 50 | Adults | 64 | E-reader | No | - | Lusting for Jenny, Inverted | MC and sorting: literal & inferential & spatiotemporal |
| March (1999) | Master thesis | Within/ between | Canada | 25 | 3rd grade | 56 | Computer | Yes | Entertaining and non-entertaining | Thomas Snowsuit; Northern Lights: The Soccer Trails | OQ: literal & inferential |
| . Margolin et al.(2013) | Journal | Between | USA | 90 | University | 74.44 | E-reader, computer | No | - | Narrative text | MC: inferential |

(*Continued*)

**Table 1.** (Continued).

| Study | Type of publication | Study design | Study location | Sample size | Age group | % women/ girls | Digital reading device | Interactive and/ or multimedia functions | Type of addtional function | Stimulus text | Type of comprehension test |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Margolin et al. (2018) | Journal | Within | USA | 60 | University | 66.67 | E-reader | No | - | Narrative text | MC: literal, inferential |
| Matthew (1997), study 1 | Journal | Between | USA | 74 | Primary school | 54.05 | Computer | Yes | Entertaining and non-entertaining | Arthur's Teacher Trouble; Mud Puddle; Arthur's Birthday | Retelling & OQ: literal & inferential |
| McCrea-Andrews (2014) | Dissertation | Between | USA | 36 | 6th grade | 55.56 | E-reader | Yes | Non-entertaining only | Sounder | MC & OQ: literal & inferential |
| Moyer (2011) | Dissertation | Within | USA | 66 | University | 100 | E-reader | No | - | Dogs of Riga; Bloodwork; Fatally Flaky | MC: literal & inferential |
| Muter et al. (1982) | Journal | Between | Canada | 32 | Adults | Not mentioned | Television | No | - | The Complete Works of Saki | MC |
| Pearman (2008) | Journal | Within | USA | 54 | 2nd grade | 46.3 | Computer | Yes | Entertaining and non-entertaining | Mud Puddle; Moving Gives Me a Stomachache; Thomas' Snowsuit, The Paper Bag Princess; Heather Hits Her First Home Run; A Long Hard Day on the Ranch | Retelling |
| Rasmusson (2014) | Journal | Within | Sweden | 117 | 14–15 year olds | 54.7 | Computer | No | - | Fox; Mute | MC |
| Schwabe et al. (2021) | Journal | Between | Austria | 207 | Adults | 81.16 | E-reader | No | - | Schöne Freunde (Nice friends) | MC, OQ, sorting: literal & spatiotemporal |
| Seehafer (2014) | University journal | Between | USA | 67 | University | Not mentioned | Computer | No | - | The Men of Brewster Place | MC |
| Stevens (2014) | Dissertation | Between | USA | 284 | 7th & 8th grade | 47.89 | Computer | Yes & no | Non-entertaining only | The Masque of the Red Death | MC |
| Subrahmanyam et al. (2013) | Journal | Between | USA | 120 | University | 50 | Computer, tablet | No | - | Narrative text | MC: literal, inferential |
| Wells (2012) | Dissertation | Between | USA | 138 | 6th–12th grade | Not mentioned | Tablet | No | - | Chasing Lincoln's Killer: The search for John Wilkes Booth | MC |

Additionally, we repeated the meta-regression analysis using the whole sample with the for the research question relevant variables publication year, additional digital functions, and digital reading device type, and with the control variables publication type, study design, and sample age-group as moderators. To further investigate the effect of different additional functions, we conducted a meta-regression with only the studies with additional functions as sample and the type of function (entertaining and non-entertaining functions or non-entertaining comprehension supporting functions only) as moderators. As study-design did not turn out to be a significant moderator, we did not split our sample in different analyses for within-particpant and between-participant design studies.

To check for a possible publication bias, we used an Egger Sandwich test. The Egger Sandwich test combines Egger's regression test with RVE and is therefore suitable for models with dependent effect sizes (Rodgers & Pustejovsky, 2021). Further, because the estimation of the correlation of the effect sizes was set to the arbitrary $\rho = .8$, we also conducted the analyses with $\rho = 0$, $\rho = .2$, $\rho = .4$, $\rho = .6$, $\rho = 1$ to examine how sensitive the model was to differing $\rho$-values. Due to the non-significant result of the main analysis, we used the *TOSTER* R package (Lakens, 2017) to conduct two one-sided tests to examine the equivalence of the result to zero with the lower and upper bound set to $d = -0.25$ and $d = 0.25$ and a null hypothesis test. For all analyses, the level of significance was set to $p = .05$.

## Results

### Overall Analysis

In RQ1, we asked if the reading comprehension differs when the same narrative text is read on a screen versus in print. The results of the meta-analysis using the whole sample ($k = 32$) do not suggest a significant difference in reading comprehension of a narrative text between reading an e-book and reading in print ($d = 0.10$, $SE = 0.06$, $p = .12$, 95% CI [−0.03, 0.22]). However, the heterogeneity was high ($I^2 = 74.25\%$, $\tau^2 = 0.10$). The first moderator analysis showed that neither the primary study design nor the type of publication significantly influenced the observed effect (see Table 2).

### The Effect of Additional Multimedia/interactive Functions

In RQ2, we asked if reading comprehension differs between reading narrative multimedia/ interactive books and reading the same text in a printed version. The moderator analysis using the whole sample showed a significant difference in reading comprehension between reading stimuli with and without multimedia/interactive functions (see Table 2). The subgroup analyses revealed that the reading medium does not affect the comprehension of a narrative text when the e-book version does not contain interactive or multimedia functions, thus is more similar to the printed book. When there are no multimedia functions or additional support ($k = 21$), such as dictionaries, added to the text, the effect of the reading medium on reading comprehension is almost zero and not significant ($d = -0.02$, SE = 0.06, $p = .67$, 95% CI [−0.14, 0.09], $\tau^2 = 0.07$, $I^2 = 71.40\%$). However, when multimedia or interactive functions are present ($k = 12$), the positive effect of the digital reading medium on comprehension is small but significant ($d = 0.37$, $SE = 0.11$, $p < .01$, 95% CI [0.13, 0.61] $\tau^2 = 0.12$, $I^2 = 69.15\%$), indicating that multimedia/ interactive functions aid reading comprehension when the stimulus is a narrative text. However, while the sample age group was not a significant factor (see Table 2), it needs to be mentioned that all primary studies using multimedia/ interactive functions were conducted on school children (2nd–12th grade). This may mean that reading comprehension skills are embedded in the school and learning context and might be, therefore, measured and tested differently than in studies on adults (e.g., different texts and test complexities and group vs. single testing situations).

Our RQ3 was if different types of additional digital functions affect the reading comprehension differently compared to print when reading a narrative text. Nevertheless, the moderator analyses using the additional functions sub-sample revealed no difference in reading comprehension when additional to the reading supporting functions, like dictionaries or pronunciation functions, entertaining multimedia functions, like animations, sound effects, and/or sound effects, were implemented in the digital version of the text compared when only reading supporting, non-entertaining functions were present ($b$ = 0.07, $SE$ = 0.20, $p$ = .74, 95% CI [−0.40, 0.54]).

### Change of Effect over Time

The RQ4 was if the reading medium's effect on comprehension when reading a narrative text changed over time. The moderator analysis did not show a significant effect of the publication year on the reading medium's impact on reading comprehension (see Table 2). Therefore, the reading medium's effect on reading comprehension of a narrative text seems not to be affected by the publication year and, thus, did not change significantly over time.

### Different Digital Reading Devices

The last research question, RQ5, was if different digital reading devices differ in their effect on reading comprehension compared to print, when reading a narrative text. The moderator analysis did not show a significant difference in the effect on reading comprehension between the different reading devices, computer, tablet, e-reader, smartphone, and television, in comparison to print (see Table 2). The reading device computer did not significantly differ in its effect on reading comprehension compared to print ($d$ = 0.06, $SE$ = 0.08, $p$ = .45, 95% CI [−0.11, 0.23], $\tau^2$ = 0.10, $I^2$ = 75.27%). Furthermore, neither a tablet ($d$ = 0.04, $SE$ = 0.03, $p$ = .29, 95% CI [−0.07, 0.16], $\tau^2$ = 0.00, $I^2$ = 0.00%) nor an e-reader ($d$ = 0.14, $SE$ = 0.12, $p$ = .28, 95% CI [−0.14, 0.43], $\tau^2$ = 0.15, $I^2$ = 81.27%) differed significantly in its effects on reading comprehension compared to reading in print.

### Publication Bias

When used on the whole sample, the Egger sandwich test did show a significant effect ($\beta$ = 1.29, $SE$ = 0.60, $p$ = .02). However, the detected funnel plot asymmetry could have another cause than a publication bias (Rodgers & Pustejovsky, 2021). Moreover, given that the difference in effect between the peer-reviewed studies and the gray literature was not significant (see Table 2) and the fact that only 21 of the 66 effect sizes used in the meta-analysis were significant, a publication bias, which affects the non-significance of the summary effect, is not likely.

### Robustness of Results

The results of the analyses with differing estimated correlation values for the dependent effect sizes showed that the models were not sensitive to different $\rho$-values. At least up to the third decimal place, the results of all analyses were identical regardless of $\rho$. Thus, the chosen $\rho$-value of $\rho$ = .8 did not influence the results. Further, the equivalence test and the null hypothesis test suggested the observed main effect was statistically equivalent to zero (lower bound: $Z$ = 5.80, $p$ < .001; upper bound: $Z$ = −2.55, $p$ < .01) and not different from zero ($Z$ = 1.62, $p$ = .10). We can therefore conclude that in case, and contrary to our results, the effect of a reading medium on comprehension of narrative texts does exist, it is too small to be relevant.

## Discussion

In this article, we explored the impact of digital reading media on reading comprehension compared to print when reading narrative texts. In contrast to Imel (2018) and Kong, Seo, and Zhai (2018), we did not find a negative association of digital reading devices with reading comprehension. However, in their analyses, they did not differentiate between text genres and, thus, also included effects of studies using expository texts. Nevertheless, in line with the meta-analyses by Clinton (2019) and Delgado, Vargas, Ackerman, and Salmerón (2018), yet with a sample consisting of almost five times as many samples as their analyses, we also did not find a significant general effect of the reading medium on reading comprehension when reading a narrative text. Even after excluding studies using e-books with additional multimedia/interactive functions for the respective treatment groups, the results did not change much. Therefore, we did not confirm the apprehension of critics of digital reading like Baron (2015) and Wolf (2018), who give cause to consider that digital reading media could diminish the reading performance. In contrast, our results suggest a small advantage of the narrative text's digital version compared to the printed text when multimedia/ interactive functions were used. We found a positive association of multimedia/ interactive functions on reading comprehension when children read themselves, suggesting that multimedia/ interactive functions are more supportive for comprehension than distracting. These findings foster the hypothesis that positive emotions evoked by multimedia functions and interactive information processing support comprehension (Plass, Heidig, Hayward, Homer & Um, 2014; Xu & Sundar, 2016). Previous reviews with meta-analyses (Furenes, Kucirkova & Bus, 2021; Takacs, Swart & Bus, 2014; Zucker, Moody & McKenna, 2009) investigating the impact of interactive and multimedia functions on story comprehension focused mainly on children without the ability to read themselves. Furthermore, they included very diverse studies in terms of treatment and control conditions, making it difficult to extract the effect of multimedia/ interactive reading. However, they also showed that multimedia/ interactive storytelling positively affects story comprehension in children. Additionally, our results are in line with a similar meta-analysis conducted by Clinton-Lisell, Seipel, Gilpin, and Litzinger (2021). In their meta-analysis, they found a positive association between interactive reading and reading comprehension when reading an expository text. Therefore, we conclude that digital reading does not negatively affect reading comprehension when reading narrative texts but can even affect it positively due to multimedia/ interactive enrichments. However, in contrast to Takacs, Swart, and Bus (2015), who also reported a positive effect of multimedia functions on comprehension but also showed no significant effect of interactive functions, we did not find a difference between different types of additional funtions in their effect on comprehension.

The expectation (RQ4) that increased familiarity with digital media may moderate a possible negative effect of a digital reading device (Çınar, Doğan & Seferoğlu, 2019; Margolin, Driscoll, Toland & Kegler, 2013) did not hold because our results suggest that the effect of digital reading media on reading comprehension did not linearly change over time. Thus, theories, suggesting either a positive or negative change in this effect, were not confirmed. Neither better screen technology nor shallow reading processes learned in other contexts led to a change in the reading medium's effect on reading comprehension.

Moreover, we also did not find a difference between the different digital reading media in their effect on narrative reading comprehension. Çınar, Doğan, and Seferoğlu (2019) explained that the cognitive load between reading various digital reading devices and in print might be different due to small screens with different fonts, brightness, and colors affecting attention and visual perception, and Hermena et al. (2017) suggested that reading comprehension might be the same when the conditions, like luminance and contrast, are controlled for. Furthermore, we argued in an earlier article that e-ink technologies might not be inferior to paper regarding legibility. As e-readers are solely designed for reading, they might not trigger shallow reading like other digital reading devices, which are often used for skipping and scanning like a computer screen or tablet (Schwabe, Brandl,

**Table 2.** Meta regression results (whole sample).

| | *b (SE)* | *t (df)* | *p* | 95% *CI* [lower, upper] |
|---|---|---|---|---|
| Intercept | 2.74 (37.34) | 0.07 (8.94) | .94 | [−81.82, 87.29] |
| Additional functions yes | 0.35 (0.13) | 2.76 (4.28) | .047 | [0.01, 0.69] |
| Year of publication | 0.00 (0.02) | −0.08 (8.94) | .94 | [−0.04, 0.04] |
| Reading device e-reader | 0.27 (0.14) | 2.00 (11.64) | .07 | [−0.02, 0.57] |
| Reading device tablet | 0.04 (0.16) | 0.25 (4.51) | .82 | [−0.38, 0.46] |
| Reading device smartphone | 0.22 (0.17) | 1.26 (1.22) | .40 | [−1.23, 1.67] |
| Reading device television | 0.37 (0.64) | 0.57 (8.16) | .58 | [−1.11, 1.84] |
| Within-participant design | 0.09 (0.11) | 0.85 (12.24) | .41 | [−0.14, 0.32] |
| Publication in a peer-reviewed journal | −0.13 (0.11) | −1.13 (11.21) | .28 | [−0.38, 0.12] |
| Age group primary school | 0.22 (0.27) | 0.83 (6.81) | .43 | [−0.41, 0.86] |
| Age group secondary school | 0.18 (0.14) | 1.24 (10.66) | .24 | [−0.14, 0.50] |

$k = 32$; Moderators (Number of conditions and not independent sample show): additional functions (no: $k = 21$, yes: $k = 12$), year of publication, reading device (computer: $k = 20$, e-reader: $k = 9$, tablet: $k = 6$, smartphone: $k = 2$, television: $k = 1$), study design (between-participant design: $k = 22$, within-participant design: $k = 10$), type of publication (gray literature: $k = 10$, peer-reviewed journal: $k = 22$), age group (adults: $k = 12$, primary school: $k = 10$, secondary school: $k = 10$).

Boomgaarden & Stocker, 2021). However, these arguments are not sustainable as we did not find a significant difference in the impact on reading comprehension between any digital reading device compared to print.

In conclusion, the negative impact of reading on screens on reading comprehension is not present when reading narrative texts. Therefore, the genre "narrative text" probably compensates for a negative effect of digital reading media on the reading process, as shown for expository texts (e.g., Clinton, 2019; Delgado, Vargas, Ackerman & Salmerón, 2018). However, there are contradicting hypotheses as to how narrative texts affect reading from screen. On the one hand, the cognitive load of reading a narrative text might be smaller than when reading an expository text. Therefore, the reader might still have enough cognitive capacity to efficiently process the text even if additional resources are needed when reading digitally (Rasmusson, 2014; Margolin, Snyder & Thamboo, 2018). On the other hand, the mind-set of reading a narrative text might trigger a more attentive reading process compared to reading an expository text. The reader must stay alert during the act of reading because every detail of a text might be vital to the story. However, the importance or unimportance of these details reveals itself only after the story progresses and not necessarily at the moment at which the details are read (Zwaan, 1993). Thus, due to attentive reading, the effect of the reading medium might lose its strength. Moreover, with immersion in a story, the surroundings might become less relevant, and the reader could be less aware of the reading medium they are using (Green & Brock, 2000; Kuzmičová, 2014). However, more research is needed to clarify this contradiction.

Alternatively, the reason why we did not find a significant effect of the reading medium on reading comprehension of a narrative text might be due to insufficient research methods used in the primary studies. The effect might be too small to be measurable with the given instruments (Margolin, Driscoll, Toland & Kegler, 2013; Subrahmanyam et al., 2013). Additionally, most studies with a narrative text as stimuli used reading comprehension tests designed to measure reading comprehension regardless of text genre, which translates to expository texts being the default. These instruments might not be suitable for researching reading comprehension of narrative texts, and new methods need to be developed. Genre-specific properties like character development, chronology, and the situation model might need to be brought into the focus of further research more than literal comprehension questions.

This meta-analysis study is not without limitations. Since all studies incorporated into the meta-analyses regarding multimedia/ interactive functions used school students as samples to investigate the effect of digital multimedia/ interactive reading on reading comprehension, we cannot make any statements regarding the effect on more skilled readers. Further, we cannot differentiate if entertaining functions on their own affect reading comprehension because, in our sample, they were mostly paired with comprehension supporting functions, like dictionaries and pronunciation support.

Moreover, even if second language learners probably benefit most from multimedia/ interactive functions like a dictionary, we did not include second language learners in this analysis. This could also be especially important for not only narrative texts but also expository texts used for studying. Additionally, other individual differences besides the first language could play a role in the digital reading of narrative texts, like gender, working memory, personality, and preferences for a specific reading medium (Duran & Alevli, 2014; Guarisco, Brooks & Freeman, 2017; Hou, Wu & Harrell, 2017; Rasmusson, 2014; Margolin, Snyder & Thamboo, 2018). However, more research is needed to make a statement about individual differences. Additionally, the primary studies used in the meta-analyses conducted their reading comprehension tests directly after reading. Therefore, we cannot make any assumptions about the long-term effects of digital reading media on reading comprehension.

More research is needed regarding the effect of smartphones on reading comprehension. Due to the lack of studies, we were not able to conduct a meta-analysis on the effects of reading narrative texts on a smartphone. This is especially unfortunate because smartphones are becoming a more popular device for reading texts (Loh & Sun, 2019). Especially with the smartphone, there is a constant chance of getting distracted during reading, which could greatly affect the reading process. Most of the studies were conducted in controlled lab or school settings, ideal for reading without medium-specific disturbances, like the possibility to access the internet or getting messages on the same device. Future research should therefore also concentrate on studying the effect of the reading medium on reading comprehension with more external validity.

## Disclosure Statement

No potential conflict of interest was reported by the author(s).

## Funding

This work was supported by the Austrian Science Fund (FWF) [P 31723-G30].

## ORCID

Annika Schwabe http://orcid.org/0000-0002-9274-1417
Fabienne Lind http://orcid.org/0000-0002-4978-9415
Lukas Kosch http://orcid.org/0000-0002-3337-2869
Hajo G. Boomgaarden http://orcid.org/0000-0002-5260-1284

## Data Availability Statement

The data described in this article are openly available in the Open Science Framework at https://osf.io/gsut9/.

## Open Scholarship

This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at https://osf.io/gsut9/.

## References

Ackerman, R., & Goldsmith, M. (2011). Metacognitive regulation of text learning: On screen versus on paper. *Journal of Experimental Psychology: Applied*, *17*(1), 18–32. doi:10.1037/a0022086
Baron, N. S. (2015). *Words onscreen: The fate of reading in a digital world*. Oxford University Press.

Borenstein, M., Hedges, L. V., Higgins, J., & Rothstein, H. R. (2014). *Comprehensive meta-analysis version 3*. Englewood, NJ: Biostat.

Bus, A. G., Takacs, Z. K., & Kegel, C. A. (2015). Affordances and limitations of electronic storybooks for young children's emergent literacy. *Developmental Review*, *35*, 79–97. doi:10.1016/j.dr.2014.12.004

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, *8*(4), 293–332. doi:10.1207/s1532690xci0804_2

Chen, G., Cheng, W., Chang, T. W., Zheng, X., & Huang, R. (2014). A comparison of reading comprehension across paper, computer screens, and tablets: Does tablet familiarity matter? *Journal of Computers in Education*, *1*(2), 213–225. doi:10.1007/s40692-014-0012-z

Chomsky, C. (1990). Books on videodisc: Computers, video, and reading aloud to children. In D. Nix, & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 31–47). Lawrence Erlbaum Associates.

Çınar, M., Doğan, D., & Seferoğlu, S. S. (2019). The effects of reading on pixel vs. paper: A comparative study. *Behaviour & Information Technology*, 1–9. doi:10.1080/0144929X.2019.1685594

Clinton, V. (2019). Reading from paper compared to screens: A systematic review and meta-analysis. *Journal of Research in Reading*, *42*(2), 288–325. doi:10.1111/1467-9817.12269

Clinton-Lisell, V., Seipel, B., Gilpin, S., & Litzinger, C. (2021). Interactive features of E-texts' effects on learning: A systematic review and meta-analysis. *Interactive Learning Environments*, 1–16. doi:10.1080/10494820.2021.1943453

Clinton, V., Taylor, T., Bajpayee, S., Davison, M. L., Carlson, S. E., & Seipel, B. (2020). Inferential comprehension differences between narrative and expository texts: A systematic review and meta-analysis. *Reading and Writing*, *33* (9), 2223–2248. doi:10.1007/s11145-020-10044-2

D'Ambra, J., Wilson, C. S., & Akter, S. (2019). Affordance theory and e-books: Evaluating the e-reading experience using netnography. *Personal and Ubiquitous Computing*, *23*(5), 873–892. doi:10.1007/s00779-017-1086-1

Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*, *25*, 23–38. doi:10.1016/j.edurev.2018.09.003

Duncan, L. G., McGeown, S. P., Griffiths, Y. M., Stothard, S. E., & Dobai, A. (2016). Adolescent reading skill and engagement with digital and traditional literacies as predictors of reading comprehension. *British Journal of Psychology*, *107*(2), 209–238. doi:10.1111/bjop.12134

Duran, E., & Alevli, O. (2014). The effect of reading on screen on comprehension of eighth grade students. *Research in Reading & Writing Instruction*, *2*, 1–11.

Evans, S. K., Pearce, K. E., Vitak, J., & Treem, J. W. (2017). Explicating affordances: A conceptual framework for understanding affordances in communication research. *Journal of Computer-Mediated Communication*, *22*(1), 35–52. doi:10.1111/jcc4.12180

Fisher, Z., Tipton, E., & Zhipeng, H. (2017). *Robumeta: Robust variance meta-regression* (R Package Version 2).

Fox, J., & McEwan, B. (2017). Distinguishing technologies for social interaction: The perceived social affordances of communication channels scale. *Communication Monographs*, *84*(3), 298–318. doi:10.1080/03637751.2017.1332418

Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A comparison of children's reading on paper versus screen: A meta-analysis. *Review of Educational Research*, *91*(4), 483–517. doi:10.3102/0034654321998074

Graesser, A. C., & McNamara, D. S. (2011). Computational analyses of multilevel discourse comprehension. *Topics in Cognitive Science*, *3*(2), 371–398. doi:10.1111/j.1756-8765.2010.01081.x

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, *79*(5), 701–721. doi:10.1037/0022-3514.79.5.701

Greussing, E., Kessler, S. H., & Boomgaarden, H. G. (2020). Learning from science news via interactive and animated data visualizations: An investigation combining eye tracking, online survey, and cued retrospective reporting. *Science Communication*, *42*(6), 803–828. doi:10.1177/1075547020962100

Guarisco, M. S., Brooks, C., & Freeman, L. M. (2017). Reading books and reading minds: Differential effects of wonder and the crossover on empathy and theory of mind. *Study and Scrutiny: Research on Young Adult Literature*, *2*(2), 24–54. doi:10.15763/.2376-5275.2017.3.1.24-54

Hamedi, S. M., Pishghadam, R., & Fadardi, J. S. (2020). The contribution of reading emotions to reading comprehension: The mediating effect of reading engagement using a structural equation modeling approach. *Educational Research for Policy and Practice*, *19*(2), 211–238. doi:10.1007/s10671-019-09256-3

Hebert, M., Bohaty, J. J., Nelson, J. R., & Brown, J. (2016). The effects of text structure instruction on expository reading comprehension: A meta-analysis. *Journal of Educational Psychology*, *108*(5), 609–629. doi:10.1037/edu0000082

Hermena, E. W., Sheen, M., AlJassmi, M., AlFalasi, K., AlMatroushi, M., & Jordan, T. R. (2017). Reading rate and comprehension for text presented on tablet and paper: Evidence from Arabic. *Frontiers in Psychology*, *8*, 257. doi:10.3389/fpsyg.2017.00257

Hou, J., Wu, Y., & Harrell, E. (2017). Reading on paper and screen among senior adults: Cognitive map and technophobia. *Frontiers in Psychology*, *8*, 2225. doi:10.3389/fpsyg.2017.02225

Imel, R. B. (2018). *Digital reading vs. paper reading: Does mind wandering mediate comprehension differences?* (Doctoral dissertation). UC Riverside. Retrieved from https://escholarship.org/uc/item/82n4z6wj

Kaufman, G., & Flanagan, M. (2016, May). High-low split: Divergent cognitive construal levels triggered by digital and non-digital platforms. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 2773–2777). doi:10.1145/2858036.2858550

Khatri, D. (2020). Portraying screen reading behavior of college students of University of Delhi. *DESIDOC Journal of Library & Information Technology*, *40*(4), 211–217. doi:10.14429/djlit.40.04.15620

Kong, Y., Seo, Y. S., & Zhai, L. (2018). Comparison of reading performance on screen and on paper: A meta-analysis. *Computers & Education*, *123*, 138–149. doi:10.1016/j.compedu.2018.05.005

Kuzmičová, A. (2014). Literary narrative and mental imagery: A view from embodied cognition. *Style*, *48*(3), 275–293.

Lakens, D. (2017). *TOSTER: Two one-sided tests (TOST) equivalence testing* (R Package Version 0.3.4).

Lange, S. (2019). *Enhanced E-Books: eine empirische Studie zum immersiven Erleben*. Springer. doi:10.1007/978-3-476-04983-4

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLOS Medicine*, *6*(7), e1000100. doi:10.1371/journal.pmed.1000100

Loh, C. E., & Sun, B. (2019). 'I'd still prefer to read the hard copy': Adolescents' print and digital reading habits. *Journal of Adolescent & Adult Literacy*, *62*(6), 663–672. doi:10.1002/jaal.904

Mangen, A. (2016). The digitization of literary reading: Contributions from empirical research. *Orbis litterarum*, *71*(3), 240–262. doi:10.1111/oli.12095

Mar, R. A., Li, J., Nguyen, A. T., & Ta, C. P. (2021). Memory and comprehension of narrative versus expository texts: A meta-analysis. *Psychonomic Bulletin & Review*, 1–18. doi:10.3758/s13423-020-01853-1

Margolin, S. J., Driscoll, C., Toland, M. J., & Kegler, J. L. (2013). E-readers, computer screens, or paper: Does reading comprehension change across media platforms? *Applied Cognitive Psychology*, *27*(4), 512–519. doi:10.1002/acp.2930

Margolin, S. J., Snyder, N., & Thamboo, P. (2018). How should I use my e-reader? An exploration of the circumstances under which electronic presentation of text results in good comprehension. *Mind, Brain, and Education*, *12*(1), 39–48. doi:10.1111/mbe.12167

Martin-Chang, S., Kozak, S., Levesque, K. C., Calarco, N., & Mar, R. A. (2021). What's your pleasure? Exploring the predictors of leisure reading for fiction and nonfiction. *Reading and Writing*, 1–28. doi:10.1007/s11145-020-10112-7

Oakhill, J., Cain, K., & Elbro, C. (2015). *Understanding and teaching reading comprehension: A handbook* (2nd ed.). Routledge.

Plass, J. L., Heidig, S., Hayward, E. O., Homer, B. D., & Um, E. (2014). Emotional design in multimedia learning: Effects of shape and color on affect and learning. *Learning and Instruction*, *29*, 128–140. doi:10.1016/j.learninstruc.2013.02.006

Rasmusson, M. (2014). Reading paper– reading screen - A comparison of reading literacy in two different modes. *Nordic Studies in Education*, *35*(1), 3–19. doi:10.18261/1891-5949-2015-01-02

Rodgers, M. A., & Pustejovsky, J. E. (2021). Evaluating meta-analytic methods to detect selective reporting in the presence of dependent effect sizes. *Psychological Methods*, *26*(2), 141–160. doi:10.1037/met0000300

Sage, K., Piazzini, M., Downey, J. C., IV, & Masilela, L. (2020). Reading from print, laptop computer, and e-reader: Differences and similarities for college students' learning. *Journal of Research on Technology in Education*, *52*(4), 441–460. doi:10.1080/15391523.2020.1713264

Schilhab, T., Balling, G., & Kuzmicova, A. (2018). Decreasing materiality from print to screen reading. *First Monday*, *23*(10), 1–12. http://doi.org/10.5210/fm.v23i10.9435

Schwabe, A., Brandl, L., Boomgaarden, H. G., & Stocker, G. (2021). Experiencing literature on the E-reader: The effects of reading narrative texts on screen. *Journal of Research in Reading*, *44*(2), 319–338. doi:10.1111/1467-9817.12337

Subrahmanyam, K., Michikyan, M., Clemmons, C., Carrillo, R., Uhls, Y. T., & Greenfield, P. M. (2013). Learning from paper, learning from screens: Impact of screen reading and multitasking conditions on reading and writing among college students. *International Journal of Cyber Behavior, Psychology and Learning*, *3*(4), 1–27. doi:10.4018/ijcbpl.2013100101

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2014). Can the computer replace the adult for storybook reading? A meta-analysis on the effects of multimedia stories as compared to sharing print stories with an adult. *Frontiers in Psychology*, *5*, 1366. doi:10.3389/fpsyg.2014.01366

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015). Benefits and pitfalls of multimedia and interactive features in technology-enhanced storybooks: A meta-analysis. *Review of Educational Research*, *85*(4), 698–739. doi:10.3102/0034654314566989

Tanner-Smith, E. E., Tipton, E., & Polanin, J. R. (2016). Handling complex meta-analytic data structures using robust variance estimates: A tutorial in R. *Journal of Developmental and Life-Course Criminology*, *2*(1), 85–112. doi:10.1007/s40865-016-0026-5

Torppa, M., Eklund, K., Sulkunen, S., Niemi, P., & Ahonen, T. (2018). Why do boys and girls perform differently on PISA reading in Finland? The effects of reading fluency, achievement behaviour, leisure reading and homework activity. *Journal of Research in Reading*, *41*(1), 122–139. doi:10.1111/1467-9817.12103

Torppa, M., Niemi, P., Vasalampi, K., Lerkkanen, M.-K., Tolvanen, A., & Poikkeus, A.-M. (2020). Leisure reading (but not any kind) and reading comprehension support each other – A longitudinal study across grades 1 and 9. *Child Development*, *91*(3), 876–900. doi:10.1111/cdev.13241

Wolf, M. (2018). *Reader, come home: The reading brain in a digital world* (1st ed.). HarperCollins.

Xu, Q., & Sundar, S. S. (2016). Interactivity and memory: Information processing of interactive versus non-interactive content. *Computers in Human Behavior*, *63*, 620–629. doi:10.1016/j.chb.2016.05.046

Zeng, Y., Bai, X., Xu, J., & He, C. G. H. (2016). The influence of e-book format and reading device on users' reading experience: A case study of graduate students. *Publishing Research Quarterly*, *32*(4), 319–330. doi:10.1007/s12109-016-9472-5

Zucker, T. A., Moody, A. K., & McKenna, M. C. (2009). The effects of electronic books on pre-kindergarten-to-grade 5 students' literacy and language outcomes: A research synthesis. *Journal of Educational Computing Research*, *40*(1), 47–87. doi:10.2190/EC.40.1.c

Zwaan, R. A. (1993). *Aspects of literary comprehension. A cognitive approach*. John Benjamins.

### 4.3. Study 3: Experiencing Literature on the E-reader: The Effects of Reading Narrative Texts on Screen.

Schwabe, A., Brandl, L., Boomgaarden, H. G., & Stocker, G. (2021). Experiencing literature on the E-reader: The effects of reading narrative texts on screen. *Journal of Research in Reading*, *44*(2), 319–338. https://doi.org/10.1111/1467-9817.12337

*Journal of Research in Reading, ISSN 0141-0423*
*Volume 44, Issue 2, 2021, pp 319–338*
*DOI:10.1111/1467-9817.12337*

# Experiencing literature on the e-reader: the effects of reading narrative texts on screen

Annika Schwabe

Department of German Studies, University of Vienna, Vienna, Austria and
Department of Communication Science, University of Vienna, Vienna, Austria

Lukas Brandl

Department of German Studies, University of Vienna, Vienna, Austria

Hajo G. Boomgaarden

Department of Communication Science, University of Vienna, Vienna, Austria

Günther Stocker

Department of German Studies, University of Vienna, Vienna, Austria

**Background:** The digitalisation of literature is proliferating, and the increasing spread of digital reading devices and the availability of digital texts is likely to make *books on screen* a lasting phenomenon, but little attention has been paid to the consequences of digitalisation for the experience of narrative fiction. While on the one hand, reading literature on a digital reading device might trigger a superficial processing of the text, and problems regarding orientation within the narrative, the awareness of reading a literary text might, on the other hand, lead to more in-depth and complex processing, independent of reading medium. This study examines whether the reading performance and the emotional and cognitive experiences of the reception of a literary text vary between reading a printed book or an e-reader.
**Methods:** Using a between-subjects experimental design, 207 participants read the beginning of a novel either in a printed book or on an e-reader. They then completed a reading comprehension test and questionnaires about their cognitive and emotional experiences.
**Results:** Overall, the results do not suggest the clear superiority of either of the two reading media. Neither reading speed nor reading comprehension differed significantly between the two groups. Even though a broad range of reading experiences was measured, neither cognitive nor emotional reading experiences differed significantly between the groups.
**Conclusion:** An e-reader does not affect either reading performance or cognitive and emotional experience of reading a narrative text, compared with a printed book.

**Keywords:** digital reading, e-reader, reading comprehension, literary reading, fiction reading

## Highlights

*What is already known about this topic*

- Different reading media have different affordances.
- In general, reading comprehension of narrative texts does not differ between digital and paper reading.
- There is almost no empirical research into the effect of digital reading devices on reading dimensions other than comprehension.

*What this paper adds*

- Extensive research into the emotional and cognitive reading dimensions of different reading media when reading a complex literary text.
- There are no differences between an e-reader and a printed book in subjective emotional and cognitive reading experiences during reading.
- The objective reading performance (reading comprehension and reading speed) depends very little on the reading medium.

*Implications for theory, policy or practice*

- E-readers do not differ in most reading dimensions from the printed book when reading a narrative text.
- Neither the printed book nor the e-reader is superior to the other one when reading a narrative text.
- E-readers are better than their reputation.

Digital reading has become increasingly important across genres and text types. Reading the news on digital media has become commonplace over the past two decades (Thurman & Fletcher, 2019), and the consumption of e-books may remain a permanent phenomenon. Statistics related to reading as leisure show that, for instance, more than 32 million e-books, excluding textbooks, were sold in Germany in 2018, which translates to about 5% of the total book sales (Börsenverein des Deutschen Buchhandels, 2019). In the United States in 2016 and 2017, e-books made up approximately 20% of all book sales (Statista, 2018). Such a fundamental change in the way people read books, that is, on which medium, coupled with the popular assumption that the medium has an effect on the reception of information, begs the question of whether reading on screen involves different reading experiences than reading printed books.

According to the central theses of cultural studies and phenomenological theory, different reading media go hand in hand with different reading behaviours and different reading experiences, due to the varying interfaces and affordances of the reading devices and different multisensory perceptions and haptics linked to the reading medium (Chartier, 1995; Mangen, 2016). Readers are never confronted with an abstract, immaterial text, but rather with concrete objects that co-determine their understanding of the written text.

A host of prior studies have empirically addressed this matter, largely focusing on the potential differences in the actual comprehension of texts between screen and paper reading. Summing up this literature, in their recent meta-analyses, Kong, Seo, and Zhai (2018), Delgado et al. (2018) and Clinton (2019) looked at the relationship between reading medium and reading comprehension and found a significant paper-based reading advantage in comparison to digital reading. People who read on paper were better overall at recalling information that was provided in the text. The vast majority of studies addressing differential outcomes of reading in print versus reading on screen has focused on informational texts such as school books or expository texts and on the effects on a reader's understanding of such texts. Apart from a number of notable exceptions (e.g., Guarisco, Brooks, & Freeman, 2017; Haddock, Foad, Saul, Brown, & Thompson, 2019; Mangen, Olivier, & Velay, 2019), the literature so far has neglected (1) the reception of narrative and fictional e-books for leisure reading and (2) the potential effects of digital reading on a broader conception of the reading experience. While informational texts may be primarily concerned with generating understanding of the information presented, we argue that reading literature during leisure time is about more than just text comprehension.

Despite the increasingly widespread use of screens to consume literary texts, little is known about the possible effects of leisure reading on digital devices on reading performance, and especially on aspects of the reading experience. This study addresses these gaps by experimentally investigating the consequences of screen versus print reading of high-brow literature on a multitude of dimensions of the reading experience. The study focuses on e-readers as the digital substrate because they are the most common medium for reading e-books (PricewaterhouseCoopers, 2017).

The current study builds on the insights from the previous literature, but adds to these in important ways to investigate the impact of reading narrative texts on different media. First, we not only focused on performance-based facets, such as reading comprehension and reading speed, but importantly considered a great range of other aspects of the multidimensionality of literary reading. These include, among other things, absorption in the text, becoming emotionally involved, evaluating text characteristics, and effects on the current mood. Second, to enable a common literary reading experience, we used the beginning of a novel with a relatively complex structure and high ambiguity as the stimulus. Third, we provided a natural haptic experience with the original printed book, instead of printed-out papers, and the original e-book on an Amazon Kindle. The present study thus provides a highly relevant and comprehensive empirical perspective on the effects of reading literature on screen.

### *Theoretical framework*

The literature currently provides different theoretical perspectives and assumptions about why the reading experience might be expected to differ between print and screen reading. Mangen and van der Weel (2016) constructed a transdisciplinary framework describing reading as a complex process involving ergonomic, attentional, cognitive, emotional, and phenomenological dimensions, and as depending on historical, cultural, medial, textual, individual, and situational factors. Reading involves interaction with a device with specific interface affordances, and reading entails physical (in particular, manual/haptic) interaction with the reading medium (Mangen & van der Weel, 2016). Recently,

Spence (2020) referred to the multisensory experience of handling and reading books, highlighting the emotional and nostalgic associations that are triggered while interacting with a physical book and the lack of nonvisual senses in the reader's experience when reading digitally.

One assumption is that crucial sensorimotor cues, such as the tangibility, the text length overview, or where a piece of specific information is located within a book and where it is placed on a page, are limited when the text is displayed on a screen. A printed book is a three-dimensional reading medium, whereas an e-book is only displayed in two dimensions. This might lead to difficulties understanding the structure of the text and creating a cognitive map of the text. Crucial contextual information and navigational mechanisms might be missing using an e-book (Li, Chen, & Yang, 2013). Mangen et al. (2019) also offer empirical evidence for this claim. While they did not find a difference in overall reading comprehension between reading a narrative text digitally and reading the same text on paper, digital reading was associated with a poorer comprehension of chronology and reduced ability to locate specific events in the text.

A crucial aspect of research into the digitalisation of reading involves outcomes that can be classified as reading performance, considering the comprehension of text and the speed in which text is read. Another assumption about paper-based reading advantages from this perspective is that digital reading media impede in-depth processing by triggering lower level processing habits such as quick scanning or skimming a text (Lauterman & Ackerman, 2014; Kaufman & Flanagan, 2016). Digital media, as such, may thus prompt people to process texts differently simply by virtue of them being digital. Further and relatedly, the so-called cognitive control system is of importance to the reading process. This cluster of knowledge structures and processes triggered by outside information or by other cognitive goals regulates attitudes towards a specific situation (Zwaan, 1993). Applied to reading, this suggests that the material that carries the text would activate certain types of knowledge and processing routines that may affect the actual processing of the text. This indicates that approaching a literary text on a digital medium might result in faster reading time and, therefore, in poorer reading comprehension than reading in print.

Clinton's (2019) meta-analysis did not confirm that reading speed (as an indicator of skimming or in-depth processing) differs between digital and printed reading media, and other studies not included in their analysis have come to similar conclusions. For skilled readers, there does not seem to be a difference in reading speed on a computer screen (Köpper, Mayr, & Buchner, 2016; Çınar, Doğan, & Seferoğlu, 2019) or an e-reader (Siegenthaler, Wurtz, Bergamin, & Groner, 2011; Cavalli et al., 2019) compared with reading the same text in print. Of course, this largely contradicts the assumptions mentioned before; however, more specific research on reading performance, especially using complex narrative texts, is necessary to determine the effects of the medium concerning leisure reading. Therefore, and taking into account the inconclusiveness of prior empirical findings, we ask

**RQ1** *Does reading* performance *(reading speed and different aspects of reading comprehension) depend on the reading medium when reading a narrative text?*

Reading performance in terms of speed and text comprehension is, however, by no means a comprehensive account of the reading experience of literary texts. Performance-based indicators lack the peculiarities of reading fiction, such as the

emotional and experiential aspects of the reading experiences. Reading narrative fiction is a complex process, which differs from the reading experience of nonliterary texts. What remains important for the understanding of the literary reading process is – predominantly pointed out by theorists of reader-response criticism (Tompkins, 1980) – the notion of the reader's dynamic activity throughout the text, and the realisation that the meaning of a literary text is not a stable and fixed entity, but that the variable result of an individual construction process (Iser, 1978; Gerrig, 2011). This construction process consists of the interplay between different levels, and it is determined by the text, the concrete reader, the reading environment and, which we claim is also fundamental, by the reading device. One key element of the literary experience is that readers shift into the fictitious world that the text designs, which Gerrig (1993) popularised as the term *transportation*, the impression of leaving the real world and visiting narrative worlds. *Immersion* and *absorption* are alternative concepts related to transportation and used synonymously in the relevant academic discourse. Another crucial dimension of the specific experience with literary texts is emotional involvement in the narrative, which is strongly associated with narrative coherence and absorption, combining affective and cognitive dimensions (Busselle & Bilandzic, 2009).

Mangen and Kuiken (2014) noted that, to their knowledge, they were the first to empirically study the effect of the reading medium on transportation and empathy. Still today, the body of empirical literature is sparse and does not come to a uniform conclusion about the differences in reading experiences when reading digitally or on paper. On the one hand, the phenomenological characteristics and the handling of the reading medium must not be distracting, so that the reader can easily be transported into the story (Mangen & Kuiken, 2014). On the other hand, when the reader is transported into the story, the actual reading medium could become irrelevant, as does the rest of the physical surroundings (Kuzmičová, 2014).

Mangen et al. (2019) and Lange (2019) did not find an effect of the reading medium on transportation, but the results found by Haddock et al. (2019) were inconclusive. They presumed that the read narrative moderates the effect of the reading medium. They found that the reading medium does not affect transportation when reading a modern story, but that transportation is disturbed when reading a traditional story digitally. Further, while the general interest in the text does not seem to depend on the reading medium (Grimshaw, Dungworth, McKnight, & Morris, 2007; Moyer, 2011), the effect of the reading medium on empathy and theory of mind are also ambiguous (Mangen & Kuiken, 2014; Guarisco et al., 2017). Kaakinen et al. (2018), however, concluded that far too little is known about the emotional and cognitive aspects of digital reading.

Considering the objectives of the integrative framework by Mangen and van der Weel (2016) and the requirement of theoretical perspectives from different disciplines and with the aim of understanding the digital literary reading process in its entire multidimensional complexity, we therefore consider those dimensions of the literary experience, which are the most commonly mentioned and examined in psychology, literary studies and educational science. In addition to transportation (we use the term absorption in our analyses) and empathy, the identification and mental visualisation of a fictitious world, fictitious characters and their actions are also basic conditions for the literary experience (Iser, 1978; Spinner, 2016). Apart from emotions that arise during the reading process, reading fiction can also have an effect on emotions after reading (Mar, Oatley, Djikic, & Mullin, 2011).

Readers can enjoy specific aesthetics in a literary text, such as its rich descriptions or dense metaphors. They might also compare it with other books they have read, make inferences about its historical or political context, their own personal situation or other dimensions beyond the concrete story and its characters. Vorderer (1994) refers to such reception of narratives as the *analysing reception*, in which different aspects of the text are analysed and evaluated from a distant stance.

Given the lack of prior research into some of these important dimensions and the inconclusiveness of extant empirical research, we ask

**RQ2** *Does the reading medium affect various dimensions of the reading experience?*

## Methods

We addressed the two research questions formulated earlier by means of an experiment in which participants were reading the same text in a printed book or on an e-reader.

### *Sample*

Given that our research interests are primarily relevant to a population that habitually reads literature, the participants were recruited via posters and flyers at bookstores, libraries, public literature reading venues, and via select social media channels. The participants received €20 remuneration for their participation in the experiment. The original sample consisted of 211 participants, but we had to exclude three participants because they did not stop reading at the endpoint and read further than instructed and one participant due to insufficient language skills. The final sample therefore consisted of 207 German-speaking participants (whole sample: 19–72 years, mean age = 29.96, 168 female, 38 male, one nonbinary; print condition: 19–68 years, mean age = 29.57, 85 female, 19 male; screen condition: 19–72 years, mean age = 30.35, 83 female, 19 male, one nonbinary).

### *Setting and procedure*

To provide a reading setting that was as natural as possible, we set up a reading chair with a reading light in which the participants sat while reading the text and were allowed to eat biscuits and drink water during reading. As part of the between-subject design, the participants were randomly assigned to read either the original printed hardcover book or the original e-book on a Kindle Paperwhite (fourth gen.). The Kindle Paperwhite has a 6-inch touch display with 300 ppi and five light-emitting diode background lights. To obtain as much external validity as possible, participants in the Kindle condition were allowed to change the font size and luminance according to their needs. Because fonts can affect the evaluation of a text's content (Kaspar, Wehlitz, von Knobelsdorff, Wulf, & von Saldern, 2015) and to better control the setting, we did not allow the participants to change the actual font type. The font was set to Bookerly, which is the Kindle's factory setting. In the printed version of the text, the font size was 10 pt and the font type was Janson. Before and after reading, the participants answered an online questionnaire on a desktop computer.

### *Reading material*

Unlike many studies, which have mostly used short stories as stimulus material, we examined the reading experience with a complex narrative and within a longer reading time frame. We chose the first 20 pages of the high-brow novel 'Schöne Freunde' (*Nice Friends*) by the contemporary Austrian author Arno Geiger (2002). We chose this text because it is a relatively unknown novel by a highly acknowledged and much-read author in Austria and Germany. It is a complex fictional text characterized by an unreliable narrator, a nonchronological order of the narrated events and a very characteristic poetic style: a curious boy, the gatekeeper of a mine, tells a quirky story about an ordinary, bourgeois village, the love affairs of its inhabitants and his search for a vanished love. The starting point of the novel is an indeterminate mine accident, which forces the people to leave the village.

### *Reading comprehension*

A team of two literary scholars and one psychologist developed an instrument to measure different aspects of reading comprehension focused on the specific literary features of the chosen text. The participants had to name the author, the title of the book and the title of the chapter they read to explore their knowledge about the paratextual information of the text. Further, according to the situation model by Zwaan, Langston, and Graesser (1995), the participants had to list every person, animal, and place mentioned in the text that they could remember. In order to measure their comprehension of the chronology, participants had to put a list of ten events into the order in which they were mentioned in the text ('discourse' in narratology) and in which they happened in the story ('histoire' in narratology). Finally, participants had to answer 20 detailed multiple-choice questions about the first part of the text, the middle part, the end part and the whole text. The multiple-choice questions had seven answers, with one of them being 'I don't know' and a varying number of true and false possibilities.

### *Reading speed*

We measured the reading time with a standard stopwatch.

### *Cognitive and emotional reading experience*

To explore the reading experience extensively, we used two different scales to measure 20 different dimensions of the cognitive and emotional reading experience after reading the text. We used the German 'Aspekte des Leseerlebens' scale (aspects of the reading experience) by Appel, Koch, Schreier, and Groeben (2002), which consists of 77 items covering 14 factors: *focus of attention*, *being absorbed in the text*, *imaginability*, *spatial presence*, *end of reception*, *excitement*, *emotional involvement*, *general reading pleasure*, *identification*, *parasocial interaction*, *cognitive involvement*, *thematic interest*, *analysing reception* and *ease of cognitive access*. The participants rated on a 6-point Likert scale how far they agreed with the statements. The Cronbach's α of these dimensions varied in our sample between .68 and .92.

We also used the 'Narrative and Aesthetic Feelings' scale by Koopman (2015). We translated the 26 original Dutch 7-point Likert items into German. The factors of this scale

were *sympathy/empathy*, *identification*, *absorption*, *empathic distress*, *attractiveness* and *foregrounding*. The Cronbach's α of these dimensions varied in our sample between .7 and .92.

### *Mood changes*

To measure changes in mood, we used the German translation of the 'Positive and Negative Affect Schedule' by Krohne, Egloff, Kohlmann, and Tausch (1996). To ensure possible mood changes occurred as a result of the experience of reading this particular text digital or on paper and not because of other factors, participants filled out the questionnaire directly before and a second time directly after reading the text. The Cronbach's α varied between .8 and .87.

### *Control questions*

To determine whether the participants had heard of the author Arno Geiger without revealing that they would read a text by this author, we asked them to fill out the German version of the 'Authors Recognition Test' version A (Grolig, Tiffin-Richards, & Schroeder, 2020) before reading the text, which we extended to include 10 Austrian authors, one of whom was Arno Geiger, and five random Austrian names. Almost half of the participants (44.9%) had heard of the author Arno Geiger before reading the text. We also asked the participants after their reading if they had read the text before. All participants were reading the text for the first time during the experiment.

### *Data analysis*

We analysed our data as planned and described in our preregistration.[1] We had two kinds of open recall questions. We analysed the items for which the participants had to list as many persons, animals and locations as they could remember by summing up all answers to one summary score. We then used this summary score in a two-tailed two-sample *t* test with the reading medium as the group variable. We calculated a summary score of the three dichotomous items (right or not right) where participants had to name the author, title of the book and title of the chapter. Because we did not know whether the items had the same level of difficulty and because with only three items, there were only four different outcomes, we treated the data as ordinal and used a two-tailed Mann–Whitney *U* test with the medium as group variable. Exploratory and additional to our preregistration, we also conducted three $Chi^2$ tests for each of the paratextual items separately.

We used pairwise absolute row differences (Bartok & Burzler, 2020) for the two chronology sorting items, using the correct answers as references and two-tailed two-sample *t* tests with the pairwise absolute row differences scores as the dependent variable and reading medium as the independent variable. We calculated a sum score for each type of multiple-choice question (about the beginning, middle, end and the whole text) and used them in a single-factor multivariate ANOVA with reading medium as the

[1]Preregistration: Schwabe, A., Brandl, L., Stocker, G., & Boomgaarden, H. (2019, December 1). Books on screen (https://doi.org/10.17605/OSF.IO/VQKC4).

independent variable. To check for possible main effects, we conducted two-tailed two-sample *t* tests with reading medium as the group variable for each type. We carried out two mixed ANOVAs to analyse the interaction between reading medium and positive and negative affect separately for the changes in positive and negative affect and two two-tailed paired sample *t* tests for each experimental condition separately for the main effects. Further, we performed for each of the 20 reading experience factors and for the reading speed a two-tailed two-sample *t* test with reading medium as the group variable.

We set the level of significance to $p < .05$

## Results

### *Reading performance*

To answer RQ1, we first considered the effects on the various types of measures that relate to the reading performance, including speed but, more importantly, various and detailed aspects of comprehension. The overall knowledge about the paratextual information was significantly better when participants read the text in the original printed book ($U = 4106.5$, $p = .002$). Further, the participants reading print were significantly better at naming the title of the book ($X^2(1, N = 207) = 29.8$, $p < .001$), but not significantly better at naming the author ($X^2(1, N = 207) = 3.04$, $p = .08$), and they were significantly worse at naming the chapter title than the participants reading the e-book ($X^2(1, N = 207) = 5.5$, $p = .02$). Participants performed the same in both conditions regarding what we refer to as situation model. Neither group was better at listing mentioned persons, animals and places ($t(205) = 1.22$, $p = .23$). In the two chronology tasks, where the participants had to sort the events into the order in which they were mentioned and in which they happened in the story, the results of the participants did not significantly differ between the two experimental groups (order mentioned in the text: $t(202) = -1.12$, $p = .27$; order happened in the story: $t(199) = -1.77$, $p = .18$). There was also no significant difference in the number of correct multiple-choice questions in general, $F(4, 202) = 1.69$, $p = .16$. There was no effect on the number of correct answers in the multiple-choice questions about the whole text, the middle part, and the end (whole text: $t(205) = 1.03$, $p = .3$; middle part: $t(205) = 0.63$, $p = .53$; end: $t(205) = 0.8$, $p = .43$); however, participants reading in a printed book scored higher in questions concerning the first part of the text ($t(205) = 2.42$, $p = .02$). Nevertheless, there was no significant difference in reading speed ($t(205) = 0.45$, $p = .65$). In sum, our results regarding RQ1 suggest only few differences in reading performance based on the range of indicators included in our study. We found differences between screen and print readers only for some paratextual information and regarding a particular set of knowledge questions.

### *Reading experiences*

The differences between reading media in various aspects of the reading experience are described here to address RQ2. There was no significant difference in mood change, $F(1, 205) = 0.3$, $p = .58$, for either positive or negative affect between the two reading media (positive affect, $F(1, 205) = 0.42$, $p = .52$; negative affect, $F(1,205) = 1.93$, $p = .166$). Reading the text did not significantly change the negative affect in either of

the groups, but positive affect decreased in both groups (print: $t(103) = 4.11$, $p < .001$; digital: $t(102) = 4.6$, $p < .001$).

On its own, the reading medium also did not have an effect on any emotional and cognitive reading dimension (Table 1). We did not find significant group differences for any of the 20 dimensions that were included, and overall, the results did not even approach conventional levels of significance.[2]

## Discussion

Although the importance of tablets, smartphones and e-readers as reading media is increasing, most research has continued to focus on computer screens as the reading device. Research is also limited in the types of text it uses and has mostly focused on informational texts (Delgado et al., 2018). Both circumstances limit the generalisability of the insights of these studies to the reality of digital literature reading. The present study addressed this shortcoming and explicitly focused on the difference between reading a narrative high-brow text on an e-reader and in a printed book. Despite a thorough experimental design, the findings do not suggest a significant difference overall between reading the text in a printed book and reading it on an e-reader.

The few exceptions arose only with regard to reading *performance* indicators. Participants in the print condition seemed able to remember the paratextual information better than the participants in the digital condition. Nonetheless, when looking at the items separately, the picture is not as clear. The participants reading in the original printed book were better at remembering the title of the book probably because they were able to look at the book cover again after reading it when closing the book and giving it back to the test administration. At the same time, there was no difference between the groups in remembering the name of the author. We cannot explain why the participants reading the e-book outperformed participants reading the printed version in naming the title of the chapter. In both conditions, the chapter title was on the same page as the first paragraph of the text and equally distinct from the rest of the text.

In line with Cavalli et al. (2019) but contrary to Mangen et al. (2019), both experimental groups performed equally well in the chronology of the story test. There was also no difference in participant knowledge of when events were described in the text. Mangen et al. (2019) used a text where the story was told in chronological order. In contrast to Mangen et al. (2019), we used a text with many flashbacks, which might be more difficult to process than a completely linear story. The construction of a cognitive map of the story might be more difficult in general, regardless of the reading medium.

[2] In addition, as described in our preregistration, we also performed analyses controlling for reading speed as an effect on the association of reading medium and reading experiences; however, the reading speed did not affect the relationship between reading medium and reading dimensions. Additionally to our preregistration and as a response to the mostly nonsignificant results, we also conducted tests of equivalence using the R package TOSTER (version 0.3.4; Lakens, 2017). We set the lower and upper bounds of equivalence to $d = |0.5|$ because that is the size of an effect where one would become aware of an average difference (Cohen, 1988). The results showed that for all comparisons that were not significant in the primary analyses, the two reading conditions are equivalent to the level of $d = 0.5$. Further, to estimate the precision of the effect sizes found, we bootstrapped the sample and repeated the analyses ($n_{Samples} = 1{,}000$). The bootstrapping analyses replicated the results as discussed earlier and thus provides further evidence for the robustness of the findings and showed that the results provided earlier are robust against sampling distributions. Tables of the tests of equivalence and bootstrapping analysis are shown in Appendices A and B. Further specific results of the analyses are available on request from the authors.

**Table 1.** Effect of the reading medium on emotional dimensions of reading

| | *df* | *t* | *MD* (*SE*) | *MD* Lower CI (95%) | *MD* Upper CI (95%) | *M* (*SD*) print | *M* (*SD*) digital | *p* |
|---|---|---|---|---|---|---|---|---|
| Aspects of the reading experience | | | | | | | | |
| Focus of attention | 205 | −1.4 | −1.7 (0.84) | −2.82 | 0.484 | 15.38 (5.85) | 16.54 (6.21) | .16 |
| Being absorbed in the text | 205 | 1.18 | 0.88 (0.75) | −0.59 | 2.35 | 15.46 (5.17) | 14.58 (5.56) | .24 |
| Imaginability | 205 | 0.2 | 0.16 (0.85) | −1.4 | 1.72 | 18.38 (5.6) | 18.22 (5.81) | .84 |
| Spatial presence | 205 | 0.31 | 0.26 (0.85) | −1.41 | 1.94 | 15.95 (5.76) | 14.69 (6.45) | .76 |
| End of reception | 205 | 0.39 | 0.21 (0.54) | −0.86 | 1.28 | 12.47 (4.00) | 12.26 (3.79) | .7 |
| Excitement | 205 | 1.06 | 0.69 (0.65) | −0.6 | 1.97 | 16.17 (4.80) | 15.49 (4.57) | .29 |
| Emotional involvement | 205 | 1.71 | 1.26 (0.74) | −0.2 | 2.72 | 16.04 (5.56) | 14.78 (5.04) | .09 |
| General reading pleasure | 205 | 0.24 | 0.23 (0.93) | −1.6 | 2.05 | 18.77 (6.95) | 18.54 (6.34) | .81 |
| Identification | 205 | −0.86 | −0.97 (1.12) | −3.17 | 1.24 | 28.41 (7.69) | 29.38 (8.37) | .39 |
| Parasocial interaction | 205 | −0.38 | −0.24 (0.65) | −1.52 | 1.03 | 11.14 (4.54) | 11.39 (4.75) | .71 |
| Cognitive involvement | 205 | 0.2 | 0.14 (0.71) | −1.26 | 1.54 | 15.36 (4.72) | 15.21 (5.47) | .84 |
| Thematic interest | 205 | −1.12 | −0.77 (0.69) | −2.13 | 0.59 | 13.40 (4.96) | 14.17 (4.97) | .27 |
| Analysing reception | 205 | 0.48 | 0.46 (0.97) | −1.45 | 2.38 | 30.2 (7.12) | 29.74 (6.82) | .63 |
| Ease of cognitive access | 205 | −0.38 | −0.3 (0.77) | −1.82 | 1.23 | 15.39 (5.47) | 15.69 (5.63) | .7 |
| Narrative and aesthetic feelings | | | | | | | | |
| Sympathy/empathy | 197.65 | 0.01 | 0.01 (1.04) | −2.03 | 2.05 | 26.10 (6.73) | 26.09 (8.11) | .99 |
| Identification | 197.72 | 0.3 | 0.16 (0.53) | −0.89 | 1.21 | 8.31 (4.20) | 8.15 (3.43) | .76 |
| Absorption | 205 | 0.62 | 0.62 (1) | −1.34 | 2.58 | 18.99 (7.06) | 18.37 (7.27) | .53 |
| Empathic distress | 205 | 0.02 | 0.02 (0.81) | −1.58 | 1.61 | 9.12 (5.69) | 9.10 (5.95) | .98 |
| Attractiveness | 205 | −0.12 | −0.11 (0.89) | −1.85 | 1.64 | 18.00 (6.50) | 18.11 (6.23) | .9 |
| Foregrounding | 205 | 1.1 | 0.74 (0.67) | −0.58 | 2.06 | 15.49 (4.84) | 14.75 (4.79) | .27 |

CI, confidence interval

Neither of the two experimental groups exceeded the other in listing characters, places, or animals, contrasting with the results of Margolin, Snyder, and Thamboo (2018). In general, the participants in the two conditions did not differ in answering detailed multiple-choice questions. The only exception was the questions about the first part of the text. Participants who read the printed version were able to answer these questions significantly better than the participants who read the digital version, supporting findings by Mangen et al. (2019). They suggest that the haptic clues of the physical book might support the formation of a better cognitive map, which helps with remembering information that was acquired less recently as the information about the middle and the last part of the text. Again in line with Cavalli et al. (2019), we did not find a significant difference in reading speed.

Despite these few differences in reading performance, there was no discernible effect of the medium on the literary *experience*, which is possibly the more important part of leisure literature reading. Even though our analysis was very comprehensive and extensive in terms of the number of different dimensions of the literary experience, we did not find that the reading medium had an effect on any of these. None of the factors described by Appel et al. (2002) and Koopman (2015) were significantly affected by the reading medium. Changes in mood were also not dependent on the medium. These results mostly coincide with the sparse available literature on the impact of an e-reader on emotional and cognitive reading dimensions (e.g.,Moyer, 2011; Mangen et al., 2019), yet provide a more comprehensive and elaborate account in comparison.

The results are perhaps not surprising. The affordances of an e-reader are more similar to the affordances of a printed book than to the affordances of a computer, tablet, or smartphone. While multimedia devices can also be used for a broad range of different activities, printed books and e-readers are designed simply for the purpose of reading. They might not trigger the digital media effect of less in depth-processing as described by Lauterman and Ackerman (2014). The eye movements while reading on e-ink displays are also similar to those while reading in print. Compared with liquid crystal displays, the font-background-contrast of an e-reader can be similar to paper, and e-ink provides good visibility in varying light conditions. The legibility of an e-reader may therefore not be inferior to print. If anything, the legibility of e-readers might be better than those of print because the font size can be individually optimised (Siegenthaler et al., 2011).

Both Delgado et al. (2018) and Clinton (2019) also used text type as a moderating variable and found that the superiority of reading in print is only present when informational texts were read and not when narrative texts were read. With narrative texts as stimuli, the meta-analyses both found no difference between reading on screens and on paper. Knowledge about the effects of digital reading of informational texts therefore cannot be directly transferred to the reading of narrative texts. Simply the assumption of reading a literary text triggers a specific control system in the minds of readers, which regulates the comprehension of the text (Zwaan, 1993). Although the same text is read, there are differences in neuronal processing with different paratextual framing, depending on whether readers believe they are reading a factual or fictional text (Altmann, Bohrn, Lubrich, Menninghaus, & Jacobs, 2014). When reading a literary text, the eventual importance of every described aspect is primarily unknown, and the meanings of the total picture unfold during the reading process. Literary reading therefore involves more attention to the textbase, the surface structure and a relatively good memory of verbatim

information (Zwaan, 1993; Rosebrock, 2018). The immersion might lead to less awareness of the real world (Green & Brock, 2000), and therefore, the reading medium could fade into the background. It is possible that the more text-focused reading strategy while reading narratives means that the reading medium loses importance.

Our study is not without limitations. Although our results strongly suggest no difference between reading a narrative text on an e-reader and in print, the insights may not travel to digital reading in general. Further, we chose to let participants set the font size to their preference and did not align the digital and the printed versions of the text, so that the differences between reading on an e-reader and in a printed book, might have actually arisen due to the difference in words per page and not due to different reading media. This has not yet been empirically explored with a novel as stimulus, but Hou, Rashid, and Lee (2017) were able to show that reading comprehension and immersion in reading a comic were the same between the digital and the printed versions when they had the same amount of panels per page. Reading comprehension was worse when there was only one panel per page compared with the other conditions. Further, in our experiment, the situation, as well as the chosen text, were artificial because both were completely chosen by us, while leisure reading is, in most cases, an intrinsically motivated action. The controlled lab setting might also trigger a mindset similar to an exam situation because the participants know they will be tested after reading. Most external or medium-specific distractions are eliminated or controlled for in a lab setting, which also limits the generalisability of the results. Other methods, such as mobile experience sampling in a natural setting, might thus be worth exploring when studying leisure reading.

Future research should continue to use the authentic printed book as a comparison medium for different digital reading devices. In spite of the importance of mobile reading in general, the difference in reading a narrative text in print and reading on a smartphone has to our knowledge barely been explored. Future research should resume investigation of the importance of individual differences for the digital reading process. Different levels of working memory, as well as personality, were shown to affect digital reading (Hou, Wu, & Harrell, 2017; Margolin et al., 2018), but the studies have not been replicated yet. Exploring digital reading in large and diverse samples could therefore shed light on the differences in digital fiction reading.

Probably the biggest research gap within this field is the actual difference between reading a narrative and an informational text on screen. Studies using an informational text show the superiority of reading in print over reading on screen, but studies using a narrative text fail to show this effect (Clinton, 2019; Delgado et al., 2018). Despite our theoretical assumptions, the reason for this is still unclear and needs further investigation, with an accurate focus on the specific textual features and particular effects of literary texts.

## Conclusions

While other studies suggest that the reading medium might have an effect on the reading performance, we did not find such a coherent effect for printed books vs e-readers. Most of our results did not reach significance, indicating that the reading performance was not significantly dependent on the reading medium and did not differ between reading the same high-brow literary text in the original printed book and the original e-book on a Kindle. Further, we did not find a single significant result suggesting that the emotional and

cognitive literary experiences during reading might be positive or negative due to an e-reader in comparison with the printed version. Our results cannot be simply transferred to digital reading in general, however, due to the different affordances of e-readers and other digital reading devices. Because literary reading takes place more and more not only in the printed book or on the e-reader, the important question is still which medium triggers which cognitive control system due to its specific affordances and variety of applications. More research concerning literary reading with tablets and especially smartphones would therefore be worthwhile in order to understand the overall consequences of digital reading.

## Acknowledgements

We thank our student research assistants Luana Tschernutter and Sophia Wichelhaus, for their help conducting the experiment.

## Conflict of interest

We have no known conflict of interest to disclose.

## Funding

The results presented here are part of the 'Books on Screen' project P 31723-G30, funded by the Austrian Science Fund (FWF).

## Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## References

Altmann, U., Bohrn, I.C., Lubrich, O., Menninghaus, W. & Jacobs, A.M. (2014). Fact vs fiction – how paratextual information shapes our reading processes. *Social Cognitive and Affective Neuroscience*, 9(1), 22–29. https://doi.org/10.1093/scan/nss098

Appel, M., Koch, E., Schreier, M. & Groeben, N. (2002). Aspekte des leseerlebens: skalenentwicklung. *Zeitschrift für Medienpsychologie*, 14(4), 149–154. https://doi.org/10.1026//1617-6383.14.4.149

Bartok, L. & Burzler, M.A. (2020). How to assess rater rankings? A theoretical and a simulation approach using the sum of the pairwise absolute row differences (PARDs). *Journal of Statistical Theory and Practice*, 14(3), 37. https://doi.org/10.1007/s42519-020-00103-w

Börsenverein des Deutschen Buchhandels (2019). Back to the readers – Germany's book market 2018/2019. https://www.boersenverein.de/markt-daten/marktforschung/wirtschaftszahlen/

Busselle, R. & Bilandzic, H. (2009). Measuring narrative engagement. *Media Psychology*, 12(4), 321–347. https://doi.org/10.1080/15213260903287259

Cavalli, E., Colé, P., Brèthes, H., Lefevre, E., Lascombe, S. & Velay, J.L. (2019). E-book reading hinders aspects of long-text comprehension for adults with dyslexia. *Annals of Dyslexia*, 69(2), 243–259. https://doi.org/10.1007/s11881-019-00182-w

Chartier, R. (1995). *Forms and Meanings. Texts, Performances, and Audiences from Codex to Computer.* Philadelphia: University of Pennsylvania Press.

Çınar, M., Doğan, D. & Seferoğlu, S.S. (2019). The effects of reading on pixel vs. paper: a comparative study. *Behaviour & Information Technology*, 1–9. https://doi.org/10.1080/0144929X.2019.1685594

Clinton, V. (2019). Reading from paper compared to screens: a systematic review and meta- analysis. *Journal of Research in Reading*, 42(2), 288–325. https://doi.org/10.1111/1467-9817.12269

Cohen, J. (1988). *Power Analysis for the Behavioral Sciences*. Hillsdale: L Erlbaum.

Delgado, P., Vargas, C., Ackerman, R. & Salmerón, L. (2018). Don't throw away your printed books: a meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*, 25, 23–38. https://doi.org/10.1016/j.edurev.2018.09.003

Geiger, A. (2002). Schöne Freunde. *Hanser.*

Gerrig R. J. (1993). *Experiencing Narrative Worlds: On the Psychological Activities of Reading*. Yale University Press.

Gerrig, R. J. (2011). Conscious and unconscious processes in readers' narrative experiences. In G. Olsen (Ed.), *Current Trends in Narratology* (pp. 37–60). De Gruyter: Berlin. https://doi.org/10.1515/9783110255003.37

Green, M. & Brock, T. (2000). The role of transportation in the persuasiveness of public narrative. *Journal of Personality and Social Psychology*, 79(5), 701–721. https://doi.org/10.1037/0022-3514.79.5.701

Grimshaw, S., Dungworth, N., McKnight, C. & Morris, A. (2007). Electronic books: children's reading and comprehension. *British Journal of Educational Technology*, 38(4), 583–599. https://doi.org/10.1111/j.1467-8535.2006.00640.x

Grolig, L., Tiffin-Richards, S.P. & Schroeder, S. (2020). Print exposure across the reading life span. *Reading and Writing*, 33(6), 1423–1441. https://doi.org/10.1007/s11145-019-10014-3

Guarisco, M.S., Brooks, C. & Freeman, L.M. (2017). Reading books and reading minds: differential effects of wonder and the crossover on empathy and theory of mind. *Study and Scrutiny: Research on Young Adult Literature*, 2(2), 24–54. https://doi.org/10.15763/issn.2376-5275.2017.3.1.24-54

Haddock, G., Foad, C., Saul, V., Brown, W. & Thompson, R. (2019). The medium can influence the message: print-based versus digital reading influences how people process different types of written information. *British Journal of Psychology*, 111(3), 443–459. https://doi.org/10.1111/bjop.12415

Hou, J., Rashid, J. & Lee, K.M. (2017). Cognitive map or medium materiality? Reading on paper and screen. *Computers in Human Behavior*, 67, 84–94. https://doi.org/10.1016/j.chb.2016.10.014

Hou, J., Wu, Y. & Harrell, E. (2017). Reading on paper and screen among senior adults: cognitive map and technophobia. *Frontiers in Psychology*, 8, 2225. https://doi.org/10.3389/fpsyg.2017.02225

Iser, W. (1978). *The act of Reading. A Theory of Aesthetic Response*. London and Henley: Routledge.

Kaakinen, J., Papp-Zipernovszky, O., Werlen, E., Castells, N., Bergamin, P., Baccino, T. et al. (2018). Emotional and motivational aspects of digital reading. In M. Barzillai, J. Thomsom, S. Schroeder & P. van den Broek (Eds.), *Learning to Read in a Digital World*, (pp. 143–166). Amsterdam: John Benjamins Publishing.

Kaspar, K., Wehlitz, T., von Knobelsdorff, S., Wulf, T. & von Saldern, M.A.O. (2015). A matter of font type: the effect of serifs on the evaluation of scientific abstracts. *International Journal of Psychology*, 50(5), 372–378. https://doi.org/10.1002/ijop.12160

Kaufman, G., & Flanagan, M. (2016, May). High-low split: divergent cognitive construal levels triggered by digital and non-digital platforms. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, 2773–2777. https://doi.org/10.1145/2858036.2858550

Kong, Y., Seo, Y.S. & Zhai, L. (2018). Comparison of reading performance on screen and on paper: a meta-analysis. *Computers & Education*, 123, 138–149. https://doi.org/10.1016/j.compedu.2018.05.005

Koopman, E.M.E. (2015). How texts about suffering trigger reflection: genre, personal factors, and affective responses. *Psychology of Aesthetics, Creativity, and the Arts*, 9(4), 430–441. https://doi.org/10.1037/aca0000006

Köpper, M., Mayr, S. & Buchner, A. (2016). Reading from computer screen versus reading from paper: does it still make a difference? *Ergonomics*, 59(5), 615–632. https://doi.org/10.1080/00140139.2015.1100757

Krohne, H.W., Egloff, B., Kohlmann, C.W. & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der "Positive and negative Affect Schedule"(PANAS). *Diagnostica*, 42, 139–156.

Kuzmi□ová, A. (2014). Literary narrative and mental imagery: a view from embodied cognition. *Style*, 48(3), 275–293.

Lakens, D. (2017). Equivalence tests: a practical primer for *t*-tests, correlations, and meta- analyses. *Social Psychological and Personality Science*, 8(4), 355–362. https://doi.org/10.1177/1948550617697177

Lange, S. (2019). *Enhanced E-Books: Eine empirische Studie zum Immersiven Erleben*. Springer-Verlag: Berlin. https://doi.org/10.1007/978-3-476-04983-4

Lauterman, T. & Ackerman, R. (2014). Overcoming screen inferiority in learning and calibration. *Computers in Human Behavior*, 35, 455–463. https://doi.org/10.1016/j.chb.2014.02.046

Li, L.Y., Chen, G.D. & Yang, S.J. (2013). Construction of cognitive maps to improve e- book reading and navigation. *Computers & Education*, 60(1), 32–39. https://doi.org/10.1016/j.compedu.2012.07.010

Mangen, A. (2016). The digitization of literary reading. *Orbis Litterarum*, 71(3), 240–262. https://doi.org/10.1111/oli.12095

Mangen, A. & Kuiken, D. (2014). Lost in an iPad: narrative engagement on paper and tablet. *Scientific Study of Literature*, 4(2), 150–177. https://doi.org/10.1075/ssol.4.2.02man

Mangen, A., Olivier, G. & Velay, J.L. (2019). Comparing comprehension of a long text read in print book and on Kindle: where in the text and when in the story? *Frontiers in Psychology*, 10(38). https://doi.org/10.3389/fpsyg.2019.00038

Mangen, A. & van der Weel, A. (2016). The evolution of reading in the age of digitisation: an integrative framework for reading research. *Literacy*, 50(3), 116–124. https://doi.org/10.1111/lit.12086

Mar, R.A., Oatley, K., Djikic, M. & Mullin, J. (2011). Emotion and narrative fiction: interactive influences before, during, and after reading. *Cognition & Emotion*, 25(5), 818–833. https://doi.org/10.1080/02699931.2010.515151

Margolin, S.J., Snyder, N. & Thamboo, P. (2018). How should I use my e-reader? An exploration of the circumstances under which electronic presentation of text results in good comprehension. *Mind, Brain, and Education*, 12(1), 39–48. https://doi.org/10.1111/mbe.12167

Moyer, J. E. (2011). "Teens today don't read books anymore": a study of differences in comprehension and interest across formats (Doctoral dissertation). http://hdl.handle.net/11299/116037

PricewaterhouseCoopers (2017). Bevölkerungsbefragung E-Book-Nutzung in Deutschland Dezember 2017. https://www.pwc.de/de/technologie-medien-und-telekommunikation/umfrage-e-books-dezember-2017.pdf

Rosebrock, C. (2018). Strategien ästhetischen Lesens. Literarisches Lernen in rezeptionsästhetischer Perspektive. In D. Scherf & A. Bertschi-Kaufmann (Eds.), *Ästhetische Rezeptionsprozesse in Didaktischer Perspektive*, (pp. 14–27). Weinheim: Beltz Juventa.

Siegenthaler, E., Wurtz, P., Bergamin, P. & Groner, R. (2011). Comparing reading processes on e-ink displays and print. *Displays*, 32(5), 268–273. https://doi.org/10.1016/j.displa.2011.05.005

Spence, C. (2020). The multisensory experience of handling and reading books. *Multisensory Research*, 33(8), 902–928. https://doi.org/10.1163/22134808-bja10015

Spinner, K.H. (2016). Empathie beim literarischen lesen und ihre bedeutung für einen bildungsorientierten literaturunterricht. In J. Brüggemann, M.-G. Dehrmann & J. Standke (Eds.), *Literarizität. Herausforderungen für Literaturdidaktik und Literaturwissenschaft*, (pp. 187–200). Baltmannsweiler: Schneider Verlag Hohengehren.

Statista (2018). E-book sales as a percentage of total book sales in the United States in 2016 and 2017. https://www.statista.com/statistics/234102/e-book-market-share-in-the-united-states/

Thurman, N. & Fletcher, R. (2019). Has digital distribution rejuvenated readership? Revisiting the age demographics of newspaper consumption. *Journalism Studies*, 20(4), 542–562. https://doi.org/10.1080/1461670X.2017.1397532

Tompkins, J.P. (1980). *Reader-response criticism. From formalism to post-structuralism*. Baltimore MD: John Hopkins University Press.

Vorderer, P. (1994). Lesen als Handlung. In A. Barsch, G. Rusch & R. Viehoff (Eds.), *Empirische Literaturwissenschaft in der Diskussion*, (pp. 206–222). Frankfurt: Suhrkamp.

Zwaan, R.A. (1993). *Aspects of Literary Comprehension. A Cognitive Approach*. Amsterdam/Philadelphia: John Benjamins.

Zwaan, R.A., Langston, M.C. & Graesser, A.C. (1995). The construction of situation models in narrative comprehension: an event-indexing model. *Psychological Science*, 6(5), 292–297. https://doi.org/10.1111/j.1467-9280.1995.tb00513.x

## Appendix: Equivalence TOST test

| | | *df* | *t* | *p* |
|---|---|---|---|---|
| Aspects of the reading experience | | | | |
| Focus of attention | *t* Test | 205 | 1.39 | .16 |
| | TOST upper bound | 205 | −2.2 | .01 |
| | TOST lower bound | 205 | 4.99 | <.001 |
| Being absorbed in the text | *t* Test | 205 | −1.18 | .24 |
| | TOST upper bound | 205 | −4.78 | <.001 |
| | TOST lower bound | 205 | 2.42 | <.01 |
| Imaginability | *t* Test | 205 | −0.2 | .84 |
| | TOST upper bound | 205 | −3.8 | <.001 |
| | TOST lower bound | 205 | 3.4 | <.001 |
| Spatial presence | *t* Test | 205 | −0.31 | .76 |
| | TOST upper bound | 205 | −3.91 | <.001 |
| | TOST lower bound | 205 | 3.29 | <.001 |
| End of reception | *t* Test | 205 | −0.39 | .7 |
| | TOST upper bound | 205 | −3.98 | <.001 |
| | TOST lower bound | 205 | 3.21 | <.001 |
| Excitement | *t* Test | 205 | −1.06 | .29 |
| | TOST upper bound | 205 | −4.65 | <.001 |
| | TOST lower bound | 205 | 2.54 | <.01 |
| Emotional involvement | *t* Test | 205 | −1.71 | .09 |
| | TOST upper bound | 205 | −5.31 | <.001 |
| | TOST lower bound | 205 | 1.89 | .03 |
| General reading pleasure | *t* Test | 205 | −0.24 | .81 |
| | TOST upper bound | 205 | −3.84 | <.001 |
| | TOST lower bound | 205 | 3.35 | <.001 |
| Identification | *t* Test | 205 | 0.86 | .39 |
| | TOST upper bound | 205 | −2.73 | <.01 |
| | TOST lower bound | 205 | 4.46 | <.001 |
| Parasocial interaction | *t* Test | 205 | 0.38 | .71 |
| | TOST upper bound | 205 | −3.22 | <.001 |
| | TOST lower bound | 205 | 3.97 | <.001 |
| Cognitive involvement | *t* Test | 205 | −0.2 | .84 |
| | TOST upper bound | 205 | −3.8 | <.001 |
| | TOST lower bound | 205 | 3.4 | <.001 |
| Thematic interest | *t* Test | 205 | 1.12 | .27 |
| | TOST upper bound | 205 | −2.48 | <.01 |

(*Continues*)

(*Continued*)

| | | | | |
|---|---|---|---|---|
| | TOST lower bound | 205 | 4.71 | <.001 |
| Analysing reception | *t* Test | 205 | −0.48 | .63 |
| | TOST upper bound | 205 | −4.08 | <.001 |
| | TOST lower bound | 205 | 3.118 | <.01 |
| Ease of cognitive access | *t* Test | 205 | 0.38 | .7 |
| | TOST upper bound | 205 | −3.21 | <.001 |
| | TOST lower bound | 205 | 3.98 | <.001 |
| Narrative and aesthetic feelings | | | | |
| Sympathy/empathy | *t* Test | 205 | −0.01 | .99 |
| | TOST upper bound | 205 | −3.61 | <.001 |
| | TOST lower bound | 205 | 3.59 | <.001 |
| Identification | *t* Test | 205 | −0.3 | .77 |
| | TOST upper bound | 205 | −3.9 | <.001 |
| | TOST lower bound | 205 | 3.29 | <.001 |
| Absorption | *t* Test | 205 | −0.62 | .53 |
| | TOST upper bound | 205 | −4.22 | <.001 |
| | TOST lower bound | 205 | 2.97 | <.001 |
| Empathic distress | *t* Test | 205 | −0.02 | .98 |
| | TOST upper bound | 205 | −3.62 | <.001 |
| | TOST lower bound | 205 | 6.57 | <.001 |
| Attractiveness | *t* Test | 205 | 0.12 | .9 |
| | TOST upper bound | 205 | −3.48 | <.001 |
| | TOST lower bound | 205 | 3.72 | <.001 |
| Foregrounding | *t* Test | 205 | −1.11 | .27 |
| | TOST upper bound | 205 | −4.71 | <.001 |
| | TOST lower bound | 205 | 2.49 | <.01 |
| Reading comprehension (multiple-choice questions) | *t* Test | 205 | −1.71 | .08 |
| | TOST upper bound | 205 | −5.3 | <.001 |
| | TOST lower bound | 205 | 1.89 | .03 |

*Note*. The lower bound is set to $d = -0.5$ and the upper bound to $d = 0.5$.

## Appendix: Bootstrap for independent samples test

| | *MD* (*SE*) | Bias | *MD* lower CI (95%) | *MD* upper CI (95%) | *p* |
|---|---|---|---|---|---|
| Aspects of the reading experience | | | | | |
| Focus of attention | −1.7 (0.82) | 0.01 | −2.82 | 0.36 | .15 |
| Being absorbed in the text | 0.88 (.73) | 0.004 | −0.62 | 2.22 | .24 |
| Imaginability | 0.16 (0.77) | −0.02 | −1.36 | 1.71 | .82 |
| Spatial presence | 0.26 (0.83) | −0.01 | −1.41 | 1.94 | .77 |
| End of reception | 0.21 (0.54) | 0.001 | −0.85 | 1.28 | .71 |
| Excitement | 0.69 (0.65) | 0.01 | −0.57 | 2.0 | .31 |
| Emotional involvement | 1.26 (0.75) | 0.02 | −0.17 | 2.69 | .09 |
| General reading pleasure | 0.23 (0.94) | −0.01 | −1.67 | 1.99 | .8 |
| Identification | −0.97 (1.12) | −0.14 | −3.35 | 1.08 | .41 |
| Parasocial interaction | −0.24 (0.66) | 0.36 | −1.55 | 1.04 | .72 |
| Cognitive involvement | 0.14 (0.73) | −0.01 | −1.35 | 1.56 | .85 |
| Thematic interest | −0.77 (0.67) | −0.01 | −2.12 | 0.56 | .24 |
| Analysing reception | 0.46 (0.98) | −0.01 | −1.46 | 2.44 | .61 |
| Ease of cognitive access | −0.3 (0.75) | −0.1 | −1.78 | 1.28 | .69 |
| Narrative and aesthetic feelings | | | | | |
| Sympathy/empathy | 0.01 (1.02) | −0.3 | −2.02 | 1.87 | .99 |
| Identification | 0.16 (.519) | −0.002 | −0.87 | 1.17 | .79 |
| Absorption | 0.62 (.97) | −0.01 | −1.23 | 2.58 | .53 |
| Empathic distress | 0.02 (.79) | 0.02 | −1.5 | 1.57 | .98 |
| Attractiveness | | 0.001 | −1.85 | 1.61 | .9 |

(*Continues*)

(*Continued*)

| | | | | | |
|---|---|---|---|---|---|
| | −0.11 (.87) | | | | |
| Foregrounding | 0.74 (0.67) | −0.01 | −0.54 | 2.13 | .28 |
| Reading Comprehension (Multiple-choice questions) | .38 (.22) | −0.004 | −0.07 | 0.81 | .08 |

*Note*. Bootstrap results are based on 1,000 bootstrap samples.

**Annika Schwabe**, MSc BSc BA, studied psychology at the University of Vienna with a focus on research methods and statistics and studied additionally International Development Studies. She also completed the postgraduate training in Emergency Psychology and Psychological Crisis Management at the Sigmund Freud Private University and is a lecturer for statistics at the Faculty of Psychology of the University of Vienna. Since June 2019, she has been working on her dissertation in communication sciences, dealing with the cognitive, social and emotional aspects of the digitisation of fiction reading.

Mag. **Lukas Brandl** studied German literature and history at the University of Vienna and is doing research on post-war literature and philosophy. He taught German and created teaching materials for the Austrian Mediathek (project 'Interviews als Quelle'). In his doctoral thesis, he is searching for the localisation and function of the reader in literary theory.

**Hajo Boomgaarden**, PhD is a professor of empirical social science methods with a focus on text analysis at the Department of Communication, and currently the dean of the Faculty of Social Sciences at the University of Vienna. Previously, he has worked as an associate professor for Political Communication at the Amsterdam School of Communication Research and the Department of Communication at the University of Amsterdam. Currently, Hajo Boomgaarden is principle investigator of the Media Side project of the Austrian National Election Study and in the H2020 projects REMINDER and MIRROR. He serves as deputy scientific director of the Austrian Social Science Data Archive, deputy director of the Vienna Center for Electoral Research and Scientific Board member of the European Social Survey. He is the associate editor of the *Journal of Communication*. Hajo Boomgaarden's research interests focus on content analyses of media portrayals of politics, on media effects on political attitudes and behaviours, on the effects of media on cognitive processes and on methodological advances of content analysis techniques. He has (co-)authored more than 80 international journal articles and numerous book chapters on issues such as media and European integration, media election campaign and issue coverage, media effects on economic perceptions, immigration attitudes and extreme-right voting, and on framing effects.

Mag. Dr **Günther Stocker** is an associate professor for German literature at the University of Vienna; studied German literature and communication studies at the Universities of Salzburg and Zurich, 1996 PhD from the University of Salzburg; habilitation at the University of Vienna (2007); lecturer at the Universities of Rome III, Cassino, and Salzburg; APART Scholarship from the Austrian Academy of Sciences; main research areas are post-war and Cold War literature, Austrian literature, and reading research.

*Received 18 May 2020; revised version received 6 November 2020.*

**Address for correspondence:** Annika Schwabe, Department of Communication Science, University of Vienna, Vienna, Austria. Email: annika.schwabe@univie.ac.at

## 5. Key findings

### 5.1. Difference in Use of Digital and Printed Books

Relating to the first research question asking about the difference in reading practice when using digital reading devices or printed books, the survey study showed that the reading practices vary between people reading in print, reading digitally, and reading in both reading modes. Most of the people reporting they read books still read printed books, and almost half of them still read books exclusively in print, while not even ten percent read books exclusively in a digital form. Thus, it is unlikely that e-books will replace printed books completely anytime soon, nevertheless e-books do have their place in leisure reading (see Börsenverein des Deutschen Buchhandels, 2022). However, digital-only readers are more often men and, on average, younger than print-only readers, both of which are demographics usually reading fewer books (Faverio & Perrin, 2022). However, these demographics are also more open to technology in general, which fosters positive emotions towards digital reading and evokes more negative feelings in other demographics (Cai et al., 2017; Hauk et al., 2018; Hou et al., 2017). Nevertheless, it would be wrong to conclude that digital reading media cater mainly for the needs of people reading fewer books as the opposite is the case. Multi-format users (readers reading print and digital) and digital-only readers read more books than print-only readers, in more diverse reading situations, and at more diverse locations, especially in public places. Moreover, multi-format users read more diverse genres. Thus, they utilize the merits of digital reading devices, such as portability and almost unlimited access to books (D'Ambra et al., 2019; Hupfeld et al., 2013).

Further, multi-format users are more aware of their reading motivations than people reading only in print or only in digital format, but it is unclear whether multi-format users were always more aware of their reading motivations or only since they also read digitally. They might think about their reading more consciously because they have to choose the right reading medium for a text or situation (Kosch et al., 2021). However, it is also possible that they consciously wanted the choice of different reading media because they were aware of their reading motivations in the first place.

### 5.2. Diversification of Reading Through Digital Reading Devices

The survey study also shed light on the second research question, whether digital reading media diversify book reading. The results show that digital reading devices only marginally change reading practices. Digital-only readers and multi-format users did not start to read more books or diverse genres after switching to digital. However, digital-only readers

and multi-format users reported that they read in more situations and at more locations than they had before starting to use a digital reading device. Thus, the properties and usage options of digital reading devices, such as the storage ability, availability of books, and transportability (D'Ambra et al., 2019; Hupfeld et al., 2013), are probably more appealing to people who already read a lot and diverse. Therefore, for people who read a lot, the subjective possible tradeoff for these advantages in cognitive and emotional reading experiences cannot be too extensive when reading digitally instead of printed text and thus, instead of obstructing reading habits (e.g., Wolf, 2018), digital reading devices rather foster reading practices (and therefore affect the reading practices as proposed in Figure 1).

### 5.3. Differences in Cognitive Reading Dimensions Between Digital and Printed Narrative Texts

The third research question exploring the relationship of the reading mode and cognitive reading dimensions when reading narrative texts was examined in two studies. Nevertheless, even though different dimensions of reading comprehension and other cognitive reading dimensions were explored comprehensively with experimental and meta-analytic methods, the results were mainly identical. When the digital version of a text is not enriched with any additional digital multimedia or interactive features, there does not seem to be a great effect on reading comprehension or any cognitive reading experience compared to reading the same text in print. This suggests that reading strategies adopted when reading narrative e-books could be similar to the ones used when reading narrative printed books (see Baron, 2021a). In combination with previous meta-analytic findings (Clinton, 2019; Delgado et al., 2018), these findings highlight the genre differences in digital text processing (as proposed in Figure 1) as the reading comprehension of expository texts is better when reading print compared to when reading digitally. Because narrative texts are generally easier to process than expository texts (McNamara et al., 2012), the possible differences in cognitive load might not be crucial.

However, in the experiment, participants reading the text in print were better at answering questions about the first part of the text compared to the participants reading the digital version. Thus, the only dimension which could be negatively affected by a digital reading mode is related to the short-term memory of the text, indicating that the cognitive load might be too much when reading digital text, and the working memory would not be able to store the new information successfully (Margolin et al., 2018). Nevertheless, it is just one singular finding, so it would be misleading to state that the cognitive load theory (Chandler &

Sweller, 1991) was proven right. However, another indication is that when a digital text is enriched with interactive and multimedia features, the comprehension is better compared to reading a static printed text. In line with the Cognitive theory of multimedia learning, additional features seem to deliver the immediate help needed to comprehend a story (Mayer & Moreno, 2003). However, this finding might also be connected to more positive emotions during reading (e.g., Anmarkrud & Bråten, 2009) and not necessarily to the cognitive load alone. Moreover, in the experiment, the formation of a cognitive map (e.g., Hou et al., 2017) was not dependent on the reading mode. Neither the knowledge of when events happened in the story nor where they were mentioned in the text was better in either reading mode. That also indicates a similar cognitive load over the two reading modes as the cognitive map does not serve as an advantage of print reading (see (Baron, 2021b).

Further, this similarity in reading outcomes did not change over the years or is different for various digital reading devices. The meta-analytic study showed that there was no linear change in the difference between digital and print reading over time. That would contradict the shallowing hypothesis (Carr, 2010) as the use of digital reading devices has increased. Nevertheless, as the experience with digital reading devices was not included in the analysis, a statement about the shallowing hypothesis would be premature.

Moreover, results describing the effect of a digital reading medium compared to print show no difference in other cognitive reading dimensions. As the other cognitive reading dimensions explored in this dissertation center around the concept of absorption, it is likely that the story and the style of the text are more important than the reading mode, as the physical surroundings are perceived to disappear (Kuzmičová, 2014), which might expand to the text carrier as well. Thus, the reading medium might subjectively become invisible and does not disturb the reading experience in any way.

### 5.4. Differences in Emotional Reading Dimensions Between Digital and Printed Narrative Texts

The last research question asking about the effect of a digital reading device compared to print on emotional reading dimensions was also empirically explored with an experiment. Even though emotional dimensions were measured to a great extent, there were no differences found between reading on an e-reader and in print in any of the dimensions. This could be due to the limitations of the design (see Chapter 6. Limitations and Future Research). Nevertheless, also in association with the results of similar studies (e.g., Haddock et al., 2020; Mangen et al., 2019), the influence of the reading mode on emotional reading dimensions is

unlikely. Thus, similarly to the cognitive reading dimensions, the emotional reading dimensions might be more affected by the story and the style of the text than the text carrier, which might fade into the background while reading and thus becomes irrelevant for the reading experience.

## 6. Limitations and Future Research

This dissertation is not without limitations. First, as most of the effects of the reading device on the reading process were not significant, thus neither the shallowing hypothesis – that learned superficial reading strategies are used to read e-books – nor the cognitive load theory seem to fully apply. Even if there were significant differences detected between reading print and reading digital text, the origin would not have been clear. While the used self-report instruments grant access to the conscious experiences of the readers, psychophysiological measures, like eye-tracking or EEG, would have been helpful here. However, these psychophysiological measures could reduce the external validity of the experiment as the stimulus text would need to be shorter to generate a data set not too large for processing and analysis. This might, however, contradict the possibility of being fully absorbed in the text. Further, the setup needed for those psychophysiological measures, such as electrode caps or eye-tracking glasses, might feel awkward to the participants, and thus affect the reading experience. It would possibly not feel like leisure reading, but rather like the experiment it is.

Similarly, in the experimental study and in the primary studies used for the meta-analysis, the reading situation was artificial, which is problematic when studying leisure reading. The text, the reading situation, the reading time, and the reading mode and reading device were determined by the researchers and not by the readers. Thus, no individual genre or reading device preferences were considered. However, all of these aspects could have potentially skewed the results, as readers usually consciously choose when, where, and for what text they use a specific reading device (Kosch et al., 2021). Thus, an experiment where half of the participants can either use the reading medium or read the text of their choice could help to reduce this bias.

Further, the shallow reading strategy learned on digital reading devices might not only have impacted the digital reading but also the print reading and therefore worsened both reading conditions. However, testing this part experimentally is almost impossible since, nowadays, almost everyone has at least some kind of experience with digital reading devices and would be already influenced to some degree. Probably the only way is to use less popular

technologies, like virtual reality glasses, which are fundamentally different in their application than computers but are also able to show text.

Moreover, testing the cognitive load theory in other ways is especially important as the only difference in reading comprehension found in the experimental study was related to short-term memory, which replicates the findings by Mangen et al. (2019). Thus, there might be an effect of the reading mode on the storing process of new information. Additionally, there were no effects on long-term memory explored in this dissertation, which could have benefited the interpretation of this finding.

Additionally, while the participants' current mood was not affected differently by the two reading modes in the experiment, this is only a glimpse of the effects emotions could have on the digital reading process. Neither the effect of additional interactive or multimedia features on the emotions and motivation while reading, nor the general attitude towards digital reading, were tested in this dissertation. Therefore, more research is needed in this area.

Furthermore, except in the survey study, no individual differences between readers were explored. However, individual differences could have had a moderating effect on the relationship between the reading mode and the different reading dimensions. In particular, differences in working memory and experience with different reading devices could affect the digital reading performance. Further, readers with different attitudes towards reading and technology in general, and skill levels in these areas, could benefit from digital and print reading differently.

Lastly, the meta-analysis study was not able to show the effect of smartphones on reading comprehension due to the lack of studies conducted. Thus, this dissertation cannot make any statements about the possible influences of this digital reading device. However, it would have been important because a smartphone is one of the most popular reading devices used to read books (Loh & Sun, 2019; PricewaterhouseCoopers, 2017). Similarly, audiobooks are another digital way to consume books with a smartphone, and their use is on the rise (Faverio & Perrin, 2022). Thus, more research on the effects and practices of smartphones as e-book reading devices and audiobook players is needed.

## 7. Conclusion

Reading e-books is a well-established practice, with more than half of the general population of book readers using digital devices for leisure reading. Thus, understanding the effects of digital reading devices for the readers is highly relevant. Despite its limitations, this

dissertation was able to shed light on the effects of digital reading devices on leisure book reading and the reading of narrative texts.

The influence of digital reading devices on narrative reading is smaller than critics assume, as the pessimistic opinions towards digital leisure reading and its effects on the reading process in general do not seem to apply to narrative texts. In contrast, there is mostly no difference between reading digitally or printed text, and the few effects of digital reading devices on leisure and narrative reading found were positive rather than negative. Digital reading devices change reading practices in terms of reading situations and locations. Readers utilize the transportability of hand-held reading devices and read in more situations and at more locations than before. Further, even though digital reading devices seem to affect the reading of expository text negatively, probably due to shallow reading or too much cognitive load, this effect was not found for reading narrative texts. The digital reading and processing of narrative texts seem to be different from reading and processing expository texts. In controlled settings with the same static narrative text shown in different reading modes, neither the reading performance nor the readers' subjective cognitive or emotional reading experiences were affected by the reading mode. Instead of seeing the medium as the message, the medium seems to become invisible to the readers when reading a narrative text, probably due to the immersive character of the text and similar reading strategies in different reading modes. In contrast to the assumption that digital reading devices diminish the reading process, additional interactive and multimedia features even help with children's reading comprehension. Thus, it is more likely that the pessimistic opinions are actually rooted more in the reading situation than the use of digital reading media itself. Digital reading devices are preferred when readers do not have much time to read and in public reading locations with more distractions than at home. Neither situation is ideal for immersed reading, and might result in more superficial processing.

So, the conclusion of this dissertation is more positive than expected regarding the consequences of the digitalization of narrative texts on readers. It is unlikely that leisure e-book reading will vanish in the near future and this dissertation argues that we should not worry about it too much. According to the insights presented here, specialized digital reading devices foster book reading practices without diminishing the reading performance and the reading experience when reading stories.

## 8. References


Altmann, U., Bohrn, I. C., Lubrich, O., Menninghaus, W., & Jacobs, A. M. (2014). Fact vs Fiction— how paratextual information shapes our reading processes. *Social Cognitive and Affective Neuroscience*, *9*(1), 22–29. https://doi.org/10.1093/scan/nss098

Anmarkrud, Ø., & Bråten, I. (2009). Motivation for reading comprehension. *Learning and Individual Differences*, *19*(2), 252–256. https://doi.org/10.1016/j.lindif.2008.09.002

Annisette, L. E., & Lafreniere, K. D. (2017). Social media, texting, and personality: A test of the shallowing hypothesis. *Personality and Individual Differences*, *115*, 154–158. https://doi.org/10.1016/j.paid.2016.02.043

Appel, M., Koch, E., Schreier, M., & Groeben, N. (2001). Aspekte des Leseerlebens. In P. Rössler, *Skalenhandbuch Kommunikationswissenschaft* (pp. 74–82). VS Verlag für Sozialwissenschaften.

Appel, M., Koch, E., Schreier, M. & Groeben, N. (2002). Aspekte des Leseerlebens: Skalenentwicklung. *Zeitschrift für Medienpsychologie*, *14*(4), 149–154. https://doi.org/10.1026//1617-6383.14.4.149

Ayres, L. (2008). Narrative texts. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (pp. 545–546). SAGE. https://dx.doi.org/10.4135/9781412963909.n278

Balling, G., Begnum, A. C., Kuzmičová, A., & Schilhab, T. (2019). The young read in new places, the older read on new devices: A survey of digital reading practices among librarians and Information Science students in Denmark. *Participations*, *16*(1), 197–236.

Bansal, G. (2010). Continuing e-book usage: Role of environmental consciousness, personality and past usage. *AMCIS 2010 Proceedings*, 456. https://aisel.aisnet.org/amcis2010/456

Baron, N. S. (2021a). *How we read now: Strategic choices for print, screen, and audio*. Oxford University Press.

Baron, N. S. (2021b). Know what? How digital technologies undermine learning and remembering. *Journal of Pragmatics*, *175*, 27–37. https://doi.org/10.1016/j.pragma.2021.01.011

Baron, N. S., Calixte, R. M., & Havewala, M. (2017). The persistence of print among university students: An exploratory study. *Telematics and Informatics*, *34*(5), 590–604. https://doi.org/10.1016/j.tele.2016.11.008

Benedetto, S., Carbone, A., Drai-Zerbib, V., Pedrotti, M., & Baccino, T. (2014). Effects of

luminance and illuminance on visual fatigue and arousal during digital reading. *Computers in Human Behavior*, *41*, 112–119. https://doi.org/10.1016/j.chb.2014.09.023

Best, R. M., Floyd, R. G., & Mcnamara, D. S. (2008). Differential competencies contributing to children's comprehension of narrative and expository texts. *Reading Psychology*, *29*(2), 137–164. https://doi.org/10.1080/02702710801963951

Börsenverein des Deutschen Buchhandels (2022). *E-Book-Markt 2021: Wachstum in zweitem Pandemiejahr gebremst*. Retrieved from https://www.boersenverein.de/presse/pressemitteilungen/detailseite/e-book-markt-2021-wachstum-in-zweitem-pandemiejahr-gebremst/

Bowman, L. L., Levine, L. E., Waite, B. M., & Gendron, M. (2010). Can students really multitask? An experimental study of instant messaging while reading. *Computers & Education*, *54*(4), 927–931. https://doi.org/10.1016/j.compedu.2009.09.024

Busselle, R., & Bilandzic, H. (2008). Fictionality and perceived realism in experiencing stories: A model of narrative comprehension and engagement. *Communication Theory*, *18*(2), 255–280. https://doi.org/10.1111/j.1468-2885.2008.00322.x

Cai, Z., Fan, X., & Du, J. (2017). Gender and attitudes toward technology use: A meta-analysis. *Computers & Education*, *105*, 1–13. https://doi.org/10.1016/j.compedu.2016.11.003

Carr, N. (2010). *The shallows: What the Internet is doing to our brains*. W.W. Norton & Company.

Carretti, B., Borella, E., Cornoldi, C., & De Beni, R. (2009). Role of working memory in explaining the performance of individuals with specific reading comprehension difficulties: A meta-analysis. *Learning and Individual Differences*, *19*(2), 246–251. https://doi.org/10.1016/j.lindif.2008.10.002

Cavalli, E., Colé, P., Brèthes, H., Lefevre, E., Lascombe, S., & Velay, J. L. (2019). E-book reading hinders aspects of long-text comprehension for adults with dyslexia. *Annals of Dyslexia*, *69*(2), 243–259. https://doi.org/10.1007/s11881-019-00182-w

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, *8*(4), 293–332. https://doi.org/10.1207/s1532690xci0804_2

Chen, G., Cheng, W., Chang, T. W., Zheng, X., & Huang, R. (2014). A comparison of reading comprehension across paper, computer screens, and tablets: Does tablet familiarity matter?. *Journal of Computers in Education*, *1*(2), 213–225. https://doi.org/10.1007/s40692-014-0012-z

Chen, X., & Meurers, D. (2018). Word frequency and readability: Predicting the text-level readability with a lexical-level attribute. *Journal of Research in Reading*, *41*(3), 486–510. https://doi.org/10.1111/1467-9817.12121

Clinton, V. (2019). Reading from paper compared to screens: A systematic review and meta-analysis. *Journal of Research in Reading*, *42*(2), 288–325. https://doi.org/10.1111/1467-9817.12269

Clinton, V., Taylor, T., Bajpayee, S., Davison, M. L., Carlson, S. E., & Seipel, B. (2020). Inferential comprehension differences between narrative and expository texts: A systematic review and meta-analysis. *Reading and Writing*, *33*(9), 2223–2248. https://doi.org/10.1007/s11145-020-10044-2

Clinton-Lisell, V., Seipel, B., Gilpin, S., & Litzinger, C. (2021). Interactive features of e-texts' effects on learning: A systematic review and meta-analysis. *Interactive Learning Environments*, 1–16. https://doi.org/10.1080/10494820.2021.1943453

Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. *Mass Communication & Society*, *4*(3), 245–264. https://doi.org/10.1207/S15327825MCS0403_01

Coiro, J. (2021). Toward a multifaceted heuristic of digital reading to inform assessment, research, practice, and policy. *Reading Research Quarterly*, *56*(1), 9–31. https://doi.org/10.1002/rrq.302

Collins, A. A., Compton, D. L., Lindström, E. R., & Gilbert, J. K. (2020). Performance variations across reading comprehension assessments: Examining the unique contributions of text, activity, and reader. *Reading and Writing*, *33*(3), 605–634. https://doi.org/10.1007/s11145-019-09972-5

Dalton, B., & Proctor, C. P. (2007). Reading as thinking: Integrating strategy instruction in a universally designed digital literacy environment. In D. S. McNamara (Ed.), *Reading Comprehension Strategies: Theories, Interventions, and Technologies* (pp. 423–442). Psychology Press.

D'Ambra, J., Wilson, C. S., & Akter, S. (2019). Affordance theory and e-books: Evaluating the e-reading experience using netnography. *Personal and Ubiquitous Computing*, *23*(5), 873–892. https://doi.org/10.1007/s00779-017-1086-1

Dantas, T., Mangas Vega, A., Goméz-Díaz, R., & Cordón-García, J. A. (2017). Reading research and digital reading research: An overview of the currrent scientific scenario. *Informação & Sociedade: Estudos, 27*(2), 117–131. https://doi.org/10.4324/9780203810033

Delgado, P., & Salmerón, L. (2022). Cognitive effort in text processing and reading comprehension in print and on tablet: An eye-tracking study. *Discourse Processes*, *59*(4), 237–274. https://doi.org/10.1080/0163853X.2022.2030157

Delgado, P., Vargas, C., Ackerman, R., & Salmerón, L. (2018). Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension. *Educational Research Review*, *25*, 23–38. https://doi.org/10.1016/j.edurev.2018.09.003

Evans, S. K., Pearce, K. E., Vitak, J., & Treem, J. W. (2017). Explicating affordances: A conceptual framework for understanding affordances in communication research. *Journal of Computer-Mediated Communication*, *22*(1), 35–52. https://doi.org/10.1111/jcc4.12180

Faverio, M., & Perrin, A. (2022). *Three-in-ten Americans now read e-books*. Retrieved from https://www.pewresearch.org/fact-tank/2022/01/06/three-in-ten-americans-now-read-e-books/

Furenes, M. I., Kucirkova, N., & Bus, A. G. (2021). A comparison of children's reading on paper versus screen: A meta-analysis. *Review of Educational Research*, *91*(4), 483–517. https://doi.org/10.3102/0034654321998074

Gardner, D. (2004). Vocabulary input through extensive reading: A comparison of words found in children's narrative and expository reading materials. *Applied Linguistics*, *25*(1), 1–37. https://doi.org/10.1093/applin/25.1.1

Graesser, A. C., McNamara, D. S., & Louwerse, M. M. (2003). What do readers need to learn in order to process coherence relations in narrative and expository text. In A. P. Sweet, & C. E. Snow (Eds.), *Rethinking reading comprehension* (pp. 82–98). (Solving Problems in the Teaching of Literacy). Guilford Press.

Graesser, A. C., McNamara, D. S., Louwerse, M. M., & Cai, Z. (2004). Coh-Metrix: Analysis of text on cohesion and language. *Behavior Research Methods, Instruments, & Computers*, *36*(2), 193–202. https://doi.org/10.3758/BF03195564

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101*(3), 371–395. https://doi.org/10.1037/0033-295X.101.3.371

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, *79*(5), 701–721. https://doi.org/10.1037/0022-3514.79.5.701

Green, M. C., Brock, T. C., & Kaufman, G. F. (2004). Understanding media enjoyment: The

role of transportation into narrative worlds. *Communication Theory*, *14*(4), 311–327. https://doi.org/10.1111/j.1468-2885.2004.tb00317.x

Green, M. C., Chatham, C., & Sestir, M. A. (2012). Emotion and transportation into fact and fiction. *Scientific Study of Literature*, *2*(1), 37–59. https://doi.org/10.1075/ssol.2.1.03gre

Greenfield, S. (2015). *Mind change: How digital technologies are leaving their mark on our brains*. Random House.

Guarisco, M. S., Brooks, C., & Freeman, L. M. (2017). Reading books and reading minds: Differential effects of Wonder and The Crossover on empathy and theory of mind. *Study and Scrutiny: Research on Young Adult Literature*, *2*(2), 24–54. https://doi.org/10.15763/issn.2376-5275.2017.3.1.24-54

Haddock, G., Foad, C., Saul, V., Brown, W., & Thompson, R. (2020). The medium can influence the message: Print-based versus digital reading influences how people process different types of written information. *British Journal of Psychology*, *111*, 443–459. https://doi.org/10.1111/bjop.12415

Hamedi, S. M., Pishghadam, R., & Fadardi, J. S. (2020). The contribution of reading emotions to reading comprehension: The mediating effect of reading engagement using a structural equation modeling approach. *Educational Research for Policy and Practice*, *19*, 211–238. https://doi.org/10.1007/s10671-019-09256-3

Hauk, N., Hüffmeier, J., & Krumm, S. (2018). Ready to be a silver surfer? A meta-analysis on the relationship between chronological age and technology acceptance. *Computers in Human Behavior*, *84*, 304–319. https://doi.org/10.1016/j.chb.2018.01.020

Hou, J., Wu, Y., & Harrell, E. (2017). Reading on paper and screen among senior adults: Cognitive map and technophobia. *Frontiers in Psychology*, *8*, 2225. https://doi.org/10.3389/fpsyg.2017.02225

Hu, J., & Yu, R. (2021). The effects of ICT-based social media on adolescents' digital reading performance: A longitudinal study of PISA 2009, PISA 2012, PISA 2015 and PISA 2018. *Computers & Education*, *175*, 104342. https://doi.org/10.1016/j.compedu.2021.104342

Hupfeld, A., Sellen, A., O'Hara, K., & Rodden, T. (2013). Leisure-based reading and the place of e-books in everyday life. In P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, & M. Winckler (Eds.), *Human-computer interaction – INTERACT 2013* (pp. 1–18). Springer. https://doi.org/10.1007/978-3-642-40480-1_1

Jeong, Y. J., & Gweon, G. (2021). Advantages of print reading over screen reading: A

comparison of visual patterns, reading performance, and reading attitudes across paper, computers, and tablets. *International Journal of Human–Computer Interaction*, *37*(17), 1674-1684. https://doi.org/10.1080/10447318.2021.1908668

Jiang, T., Hou, Y., & Wang, Q. (2016). Does micro-blogging make us "shallow"? Sharing information online interferes with information comprehension. *Computers in Human Behavior*, *59*, 210–214. https://doi.org/10.1016/j.chb.2016.02.008

Kaakinen, J., Papp-Zipernovszky, O., Werlen, E., Castells, N., Bergamin, P., Baccino, T., & Jacobs, A. M. (2018). Emotional and motivational aspects of digital reading. In M. Barzillai, J. Thomson, S. Schroeder, & P. van den Broek (Eds.), *Learning to read in a digital world* (pp. 141–164). John Benjamins.

Keller, A. (2012). In print or on screen? Investigating the reading habits of undergraduate students using photo-diaries and photo-interviews. *Libri*, *62*(1), 1–18. https://doi.org/10.1515/libri-2012-0001

Kendeou, P., & van den Broek, P. (2005). The effects of readers' misconceptions on comprehension of scientific text. *Journal of Educational Psychology, 97*(2), 235–245. https://doi.org/10.1037/0022-0663.97.2.235

Kim, Y., Sidtis, D. V. L., & Sidtis, J. J. (2021). Emotional nuance enhances verbatim retention of written materials. *Frontiers in Psychology*, *12*, 2273. https://doi.org/10.3389/fpsyg.2021.519729

Klimmt, C., & Vorderer, P. (2003). Media psychology "is not yet there": Introducing theories on media entertainment to the presence debate. *Presence*, *12*(4), 346–359. https://doi.org/10.1162/105474603322391596

Kolle, S. R., Shettar, I., Kumar, V., & Parameshwar, G. S. (2018). Publication trends in literature on eBooks: A Scopus-based bibliometric analysis. *Collection and Curation, 37(3),* 119–127. https://doi.org/10.1108/CC-07-2017-0027

Komeda, H., Kawasaki, M., Tsunemi, K., & Kusumi, T. (2009). Differences between estimating protagonists' emotions and evaluating readers' emotions in narrative comprehension. *Cognition and Emotion*, *23*(1), 135–151. https://doi.org/10.1080/02699930801949116

Kong, Y., Seo, Y. S., & Zhai, L. (2018). Comparison of reading performance on screen and on paper: A meta-analysis. *Computers & Education*, *123*, 138–149. https://doi.org/10.1016/j.compedu.2018.05.005

Kong, Y., Seo, Y. S., & Zhai, L. (2022). ICT and digital reading achievement: A cross-

national comparison using PISA 2018 data. *International Journal of Educational Research*, *111*, 101912. https://doi.org/10.1016/j.ijer.2021.101912

Koopman, E. M. E. (2015a). Empathic reactions after reading: The role of genre, personal factors and affective responses. *Poetics*, *50*, 62–79. https://doi.org/10.1016/j.poetic.2015.02.008

Koopman, E. M. E. (2015b). How texts about suffering trigger reflection: Genre, personal factors, and affective responses. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(4), 430–441. https://doi.org/10.1037/aca0000006

Koopman, E. M. E. (2016). Effects of "literariness" on emotions and on empathy and reflection after reading. *Psychology of Aesthetics, Creativity, and the Arts*, *10*(1), 82–98. https://doi.org/10.1037/aca0000041

Kosch, L., Stocker, G., Schwabe, A., & Boomgaarden, H. G. (2021). Reading fiction with an e-book or in print: Purposes, pragmatics and practices. A focus group study. *Scientific Study of Literature, 11*(2), 196–22. https://doi.org/10.1075/ssol.21012.kos

Kretzschmar, F., Pleimling, D., Hosemann, J., Füssel, S., Bornkessel-Schlesewsky, I., & Schlesewsky, M. (2013). Subjective impressions do not mirror online reading effort: Concurrent EEG-eyetracking evidence from the reading of books and digital media. *PloS ONE*, *8*(2), e56178. https://doi.org/10.1371/journal.pone.0056178

Kuiken, D., Phillips, L., Gregus, M., Miall, D. S., Verbitsky, M., & Tonkonogy, A. (2004). Locating self-modifying feelings within literary reading. *Discourse Processes, 38*(2), 267–286. https://doi.org/10.1207/s15326950dp3802_6

Kuijpers, M. M. (2021). Exploring the dimensional relationships of story world absorption: A commentary on the role of attention during absorbed reading. *Scientific Study of Literature, 11*(2), 266–282. https://doi.org/10.1075/ssol.20004.kui

Kulesz, P., Francis, D., Barnes, M. & Fletcher, J. (2016). The influence of properties of the test and their interactions with reader characteristics on reading comprehension. *Journal of Educational Psychology, 108*(8), 1078–1097. http://doi.org/10.1037/edu0000126

Kuzmičová, A. (2014). Literary narrative and mental imagery: A view from embodied cognition. *Style*, *48*(3), 275–293. https://doi.org/10.5325/style.48.3.0275

Kuzmičová, A., Schilhab, T., & Burke, M. (2020). m-Reading: Fiction reading from mobile phones. *Convergence*, *26*(2), 333–349. https://doi.org/10.1177/1354856518770987

Lange, S. (2019). *Enhanced E-Books. Eine empirische Studie zum immersiven Erleben*. J. B. Metzler. https://doi.org/10.1007/978-3-476-04983-4

Lee, J. (2011). Korean EFL students' reader responses on an expository text and a narrative text. *English Language & Literature Teaching*, *17*(3), 161–175.

Li, L. Y., Chen, G. D., & Yang, S. J. (2013). Construction of cognitive maps to improve e-book reading and navigation. *Computers & Education*, *60*, 32–39. https://doi.org/10.1016/j.compedu.2012.07.010

Liebers, N., & Schramm, H. (2017). Friends in books: The influence of character attributes and the reading experience on parasocial relationships and romances. *Poetics*, *65*, 12–23. https://doi.org/10.1016/j.poetic.2017.10.001

Linderholm, T., & van den Broek, P. (2002). The effects of reading purpose and working memory capacity on the processing of expository text. *Journal of Educational Psychology*, *94*(4), 778–784. https://doi.org/10.1037/0022-0663.94.4.778

Liu, Z. (2005). Reading behavior in the digital environment: Changes in reading behavior over the past ten years. *Journal of Documentation, 61*(6), 700–712. https://doi.org/10.1108/00220410510632040

Liu, Z., & Huang, X. (2016). Reading on the move: A study of reading behavior of undergraduate smartphone users in China. *Library & Information Science Research*, *38*(3), 235–242. https://doi.org/10.1016/j.lisr.2016.08.007

Loh, C. E., & Sun, B. (2019). 'I'd still prefer to read the hard copy': Adolescents' print and digital reading habits. *Journal of Adolescent & Adult Literacy*, *62*(6), 663–672. https://doi.org/10.1002/jaal.904

Mangen, A., & Kuiken, D. (2014). Lost in an iPad: Narrative engagement on paper and tablet. *Scientific Study of Literature*, *4*, 150–177. https://doi.org/10.1075/ssol.4.2.02man

Mangen, A., Olivier, G., & Velay, J.-L. (2019). Comparing comprehension of a long text read in print book and on Kindle: Where in the text and when in the story? *Frontiers in Psychology*, 1038. https://doi.org/10.3389/fpsyg.2019.00038

Mar, R. A., Li, J., Nguyen, A. T., & Ta, C. P. (2021). Memory and comprehension of narrative versus expository texts: A meta-analysis. *Psychonomic Bulletin & Review*, 28, 732–749. https://doi.org/10.3758/s13423-020-01853-1

Margolin, S. J., Snyder, N., & Thamboo, P. (2018). How should I use my e-reader? An exploration of the circumstances under which electronic presentation of text results in good comprehension. *Mind, Brain, and Education*, *12*(1), 39–48. https://doi.org/10.1111/mbe.12167

Marinus, E., Mostard, M., Segers, E., Schubert, T. M., Madelaine, A., & Wheldall, K. (2016).

A special font for people with dyslexia: Does it work and, if so, why?. *Dyslexia*, *22*(3), 233–244. https://doi.org/10.1002/dys.1527

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 43–52. https://doi.org/10.1207/S15326985EP3801_6

McCarthy, K. S. (2015). Reading beyond the lines: A critical review of cognitive approaches to literary interpretation and comprehension. *Scientific Study of Literature*, *5*(1), 99–128. https://doi.org/10.1075/ssol.5.1.05mcc

McLuhan, M. (1964/2001). *Understanding media: The extension of man*. Routledge.

McNamara, D. S., Graesser, A. C., & Louwerse, M. M. (2012). Sources of text difficulty: Across genres and grades. In J. P. Sabatini, E. R. Albro, & T. O'Reilly (Eds.), *Measuring up: Advances in how we assess reading ability* (pp. 89–116). Rowman & Littlefield Publishers, Inc.

Megalakaki, O., Ballenghein, U., & Baccino, T. (2019). Effects of valence and emotional intensity on the comprehension and memorization of texts. *Frontiers in Psychology*, *10*, 179. https://doi.org/10.3389/fpsyg.2019.00179

Miall, D. S., & Kuiken, D. (2002). A feeling for fiction: Becoming what we behold. *Poetics*, *30*(4), 221–241. https://doi.org/10.1016/S0304-422X(02)00011-6

Narvaez, D., Van Den Broek, P., & Ruiz, A. B. (1999). The influence of reading purpose on inference generation and comprehension in reading. *Journal of Educational Psychology*, *91*(3), 488–496. https://doi.org/10.1037/0022-0663.91.3.488

Naylor, J. S., & Sanchez, C. A. (2018). Smartphone display size influences attitudes toward information consumed on small devices. *Social Science Computer Review*, *36*(2), 251–260. https://doi.org/10.1177/0894439317704161

Nikolakopoulos, A., & Paraskeva, F. (2014, July). Introducing new digital challenges for reading comprehension: A case study with dedicated e-Readers. In *2014 IEEE 14th International conference on advanced learning technologies* (pp. 421–422). IEEE. https://doi.org/10.1109/ICALT.2014.126

Oh, J., Bellur, S., & Sundar, S. S. (2018). Clicking, assessing, immersing, and sharing: An empirical model of user engagement with interactive media. *Communication Research*, *45*(5), 737–763. https://doi.org/10.1177/0093650215600493

Perrin, A. (2016). *Book Reading 2016.* Retrieved from https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2016/08/PI_2016.09.01_Book-Reading_FINAL.pdf

PricewaterhouseCoopers (2017). *Bevölkerungsbefragung E-Book-Nutzung in Deutschland Dezember 2017.* Retrieved from https://www.pwc.de/de/technologie-medien-und-telekommunikation/umfrage-e-books-dezember-2017.pdf

Quinlan, J. A., & Mar, R. A. (2020). How imagination supports narrative experiences for textual, audiovisual, and interactive narratives. In A. Abraham (Ed.), *The Cambridge handbook of the imagination* (pp. 466–478). Cambridge University Press.

Rain, M., & Mar, R. A. (2021). Adult attachment and engagement with fictional characters. *Journal of Social and Personal Relationships*, *38*(9), 2792–2813. https://doi.org/10.1177/02654075211018513

Rowberry, S. P. (2016). Commonplacing the public domain: Reading the classics socially on the Kindle. *Language and Literature*, *25*(3), 211–225. https://doi.org/10.1177/0963947016652782

Salmerón, L., Strømsø, H. I., Kammerer, Y., Stadtler, M., & Van den Broek, P. (2018). Comprehension processes in digital reading. In M. Barzillai, J. Thomson, S. Schroeder, and P. van den Broek (Eds.), *Learning to read in a digital world* (pp. 91–120). John Benjamins Publishing Company.

Schneps, M. H., Thomson, J. M., Chen, C., Sonnert, G., & Pomplun, M. (2013). E-readers are more effective than paper for some with dyslexia. *PloS ONE 8*(9), e75634. https://doi.org/10.1371/journal.pone.0075634

Schneps, M. H., Thomson, J. M., Sonnert, G., Pomplun, M., Chen, C., & Heffner-Wong, A. (2013). Shorter lines facilitate reading in those who struggle. *PloS ONE*, *8*(8), e71161. https://doi.org/10.1371/journal.pone.0071161

Shi, Z., Tang, T., & Yin, L. (2020). Construction of cognitive maps to improve reading performance by text signaling: Reading text on paper compared to on screen. *Frontiers in Psychology*, *11*, 571957. https://doi.org/10.3389/fpsyg.2020.571957

Siegenthaler, E., Wurtz, P., Bergamin, P., & Groner, R. (2011). Comparing reading processes on e-ink displays and print. *Displays*, *32*(5), 268–273. https://doi.org/10.1016/j.displa.2011.05.005

Singer, L. M., & Alexander, P. A. (2017). Reading on paper and digitally: What the past decades of empirical research reveal. *Review of Educational Research*, *87*(6), 1007–1041. https://doi.org/10.3102/0034654317722961

Spjeldnæs, K., & Karlsen, F. (2022). How digital devices transform literary reading: The impact of e-books, audiobooks and online life on reading habits. *New Media & Society*. https://doi.org/10.1177/1461444822112

Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In Richard E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 19–30). Cambridge University Press. https://doi.org/10.1017/CBO9780511816819

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2014). Can the computer replace the adult for storybook reading? A meta-analysis on the effects of multimedia stories as compared to sharing print stories with an adult. *Frontiers in Psychology*, *5*, 1366. https://doi.org/10.3389/fpsyg.2014.01366

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015). Benefits and pitfalls of multimedia and interactive features in technology-enhanced storybooks: A meta-analysis. *Review of Educational Research*, *85*(4), 698–739. https://doi.org/10.3102/0034654314566989

Torppa, M., Niemi, P., Vasalampi, K., Lerkkanen, M.-K., Tolvanen, A., & Poikkeus, A.-M. (2018). Leisure reading (but not any kind) and reading comprehension support each other – A longitudinal study across grades 1 and 9. *Child Development*, *91*(3), 876–900. https://doi.org/10.1111/cdev.13241

Tuch, A. N., Bargas-Avila, J. A., Opwis, K., & Wilhelm, F. H. (2009). Visual complexity of websites: Effects on users' experience, physiology, performance, and memory. *International Journal of Human–Computer Studies*, *67*(9), 703–715. https://doi.org/10.1016/j.ijhcs.2009.04.002

Vorderer, P., Klimmt, C., & Ritterfeld, U. (2004). Enjoyment: At the heart of media entertainment. *Communication Theory*, *14*(4), 388–408. https://doi.org/10.1111/j.1468-2885.2004.tb00321.x

Wolf, M. (2018). *Reader, come home: The reading brain in a digital world*. Harper.

Wolf, M. (2021). Foreword. In N. S. Baron, *How we read now: Strategic choices for print, screen, and audio* (pp. IX–XI). Oxford University Press.

Wolfe, M. B., & Woodwyk, J. M. (2010). Processing and memory of information presented in narrative or expository texts. *British Journal of Educational Psychology*, *80*(3), 341–362. https://doi.org/10.1348/000709910X485700

Zambarbieri, D., & Carniglia, E. (2012). Eye movement analysis of reading from computer displays, eReaders and printed books. *Ophthalmic and Physiological Optics*, *32*(5), 390–396. https://doi.org/10.1111/j.1475-1313.2012.00930.x

Zhang, Y., & Kudva, S. (2014). e-Books versus print books: Readers' choices and preferences across contexts. *Journal of the Association for Information Science and Technology*, *65*(8), 1695–1706. https://doi.org/10.1002/asi.23076

Zucker, T. A., Moody, A. K., & McKenna, M. C. (2009). The effects of electronic books on

pre-kindergarten-to-grade 5 students' literacy and language outcomes: A research synthesis. *Journal of Educational Computing Research*, *40*(1), 47–87. https://doi.org/10.2190/EC.40.1.c

Zwaan, R. A. (1994). Effect of genre expectations on text comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*(4), 920–933. https://doi.org/10.1037/0278-7393.20.4.920

## Abstract

This cumulative dissertation project is located in the field of media psychology and explores the consequences of the digitalization of reading narrative texts on the reader. It consists of three independent studies and contributes to the ongoing discussion by utilizing three different methodological approaches to study behavioral, cognitive, and emotional aspects of the process digitally reading narrative texts compared to reading in print.

The first article in this dissertation is a survey study showing individual differences between digital book readers, printed book readers, and readers using digital and printed books, and different reading practices associated with digital and print reading. Digital readers and readers using both reading modes read more books than print readers and read books from more diverse genres. Further, digital reading devices foster reading in more and diverse reading locations and situations.

The second article consists of several meta-analyses and examines the differences in reading comprehension between reading digitally and reading in print. When a static text is presented digitally, the reading comprehension is not significantly different from when the text is presented in print. Further, there are no differences between various digital reading devices in their effect on reading comprehension compared to print. In contrast, digital interactive and multimedia features affect reading comprehension positively.

The third article draws its conclusions from an experimental study investigating the differences between reading a part of a novel on an e-reader or in a hardcover book. While an extensive set of emotional and cognitive reading dimensions were investigated, no relevant significant differences were found.

## Zusammenfassung

Dieses kumulative Dissertationsprojekt ist im Bereich der Medienpsychologie angesiedelt und untersucht die Auswirkungen der Digitalisierung des Lesens narrativer Texte auf den/die Leser:in. Sie umfasst drei unabhängige Studien und trägt zur laufenden Diskussion bei, indem sie drei verschiedene methodische Ansätze verwendet, um verhaltensbezogene, kognitive und emotionale Aspekte des digitalen Leseprozesses von narrativen Texten im Vergleich zum Lesen in gedruckter Form zu untersuchen.

Der erste Artikel dieser Dissertation ist eine Umfragestudie, die individuelle Unterschiede zwischen Leser:innen digitaler Bücher, Leser:innen gedruckter Bücher und Leser:innen, die digitale und gedruckte Bücher nutzen, sowie unterschiedliche Lesepraktiken im Zusammenhang mit dem digitalen und gedruckten Lesen aufzeigt. Leser:innen digitaler Bücher und Leser:innen, die beide Lesearten nutzen, lesen mehr Bücher als Leser:innen gedruckter Bücher und lesen Bücher aus mehr unterschiedlichen Genres. Außerdem fördern digitale Lesegeräte das Lesen an mehr und vielfältigeren Leseorten und in mehr und vielfältigeren Lesesituationen.

Der zweite Artikel umfasst mehrere Meta-Analysen und untersucht die Unterschiede im Leseverständnis zwischen digitalem und gedrucktem Lesen. Wenn ein statischer Text digital dargestellt wird, unterscheidet sich das Leseverständnis nicht signifikant davon, als wenn der Text in gedruckter Form gezeigt wird. Zudem gibt es keine Unterschiede zwischen den verschiedenen digitalen Lesegeräten in Bezug auf ihre Auswirkungen auf das Leseverständnis im Vergleich zu gedruckten Texten. Im Gegensatz dazu wirken sich digitale interaktive und multimediale Funktionen positiv auf das Leseverständnis aus.

Der dritte Artikel zieht seine Schlussfolgerungen aus einer experimentellen Studie, in der die Unterschiede zwischen dem Lesen eines Teils eines Romans auf einem E-Reader und in einem gebundenen Buch untersucht wurden. Obwohl eine umfangreiche Reihe von emotionalen und kognitiven Lesedimensionen untersucht wurde, konnten keine relevanten signifikanten Unterschiede festgestellt werden.