Acta Psychologica 233 (2023) 103836

Contents lists available at ScienceDirect

Acta Psychologica

journal homepage: www.elsevier.com/locate/actpsy

Mind wandering during hypertext reading: The impact of hyperlink structure on reading comprehension and attention

Teresa Schurer[a,*], Bertram Opitz[b], Torsten Schubert[a,c,*]

[a] Center of Multimedia Teaching and Learning, Martin Luther University Halle-Wittenberg, Hoher Weg 8, 06120 Halle, Germany
[b] Department of Psychology, Brandenburg Medical School, Neuruppin, Germany
[c] Department of Experimental Psychology, Martin Luther University Halle-Wittenberg, Emil-Abderhalden-Str. 26-27, 06099 Halle, Germany

ARTICLE INFO

JEL codes:
2346 Attention
2343 Learning & Memory

Keywords:
Mind wandering
Attention
Reading comprehension
Digital reading

ABSTRACT

Online reading is becoming more and more popular in learning and teaching environments. However, little is known about characteristics of hypertexts that influence on reading comprehension and attention. Some previous studies have suggested that attention failures also referred to as mind wandering (MW) occur whenever the available resources of the reader (e.g., working memory capacity; WMC) do not match the task demands (e.g., text difficulty). This study aims to investigate the effect of restructuring a linear text into different hypertext types by means of hyperlinks on MW in a cognitively demanding task like reading. We hypothesized that participants exposed to a difficult to read hypertext with networked structure engage more in task-unrelated thoughts (TUTs) compared to participants asked to read a difficult but hierarchically organized hypertext. 90 participants read either an easy or difficult version of the same unfamiliar hypertext with either a hierarchical or networked structure and with embedded thought probes. Reading comprehension and WMC measures followed. As expected, participants reading the difficult (to read) hypertext with networked link structure showed significantly more TUTs than participants reading the hierarchical link structure hypertext. In addition, readers with a low-WMC showed significantly more TUTs while reading a demanding hypertext regardless of its structure. These findings are in line with the view that mind wandering occurs if available resources do not match with task demands, and thus deepen assumptions about hyperlinks as new cohesive devices.

1. Introduction

Especially during reading, mind wandering (MW) is a well-known and frequent phenomenon, which is why the occurrence of MW in reading and understanding texts has already been investigated in a large number of studies in the past (Mrazek et al., 2013; Reichle et al., 2010; Schooler et al., 2004; Smallwood, 2011; Smallwood et al., 2008; Smilek et al., 2010). One factor that has been studied in reading is the relationship between text difficulty and MW (Feng et al., 2013; Forrin et al., 2019; Mills et al., 2017; Soemer & Schiefele, 2019). Earlier studies showed that MW occurred more often during reading of difficult compared to easier texts and that the occurrence of MW negatively affected reading comprehension particular during the difficult passages (Feng et al., 2013; Forrin et al., 2019; Mills et al., 2017; Schurer et al., 2020; Soemer & Schiefele, 2019). A previous study by Schurer et al. (2020) investigated the extent to which text difficulty in the form of increased or decreased text cohesion of expository texts affects MW and reading comprehension. Our results showed that there was more MW and lower reading comprehension when reading difficult compared to easy texts, especially when the available cognitive resources were low due to low working memory capacity (WMC). Based on these findings, the *resource-demand matching view* was proposed to predict the occurrence of MW as resulting from an interaction of different sources affecting readers' processing during text comprehension (Schurer et al., 2020; Schurer et al., 2022). In particular, the view suggests that MW will occur whenever the available cognitive resources of a reader, i.e. the WMC, the prior knowledge etc.) do not match the task demands during reading; the difficulty of the latter being determined among others by text characteristics like text cohesion and text structure. The current study is set out to investigate in more detail the potential impact of the combined interaction of these sources for the specific case of hypertexts representing characteristic examples for humans' contemporary reading activities.

The increasing availability of text sources from the world wide web

* Corresponding authors.
E-mail addresses: teresa.schurer@posteo.de (T. Schurer), Bertram.Opitz@mhb-fontane.de (B. Opitz), torsten.schubert@psych.uni-halle.de (T. Schubert).

https://doi.org/10.1016/j.actpsy.2023.103836
Received 19 April 2022; Received in revised form 4 January 2023; Accepted 9 January 2023
Available online 13 January 2023

in educational and workplace settings is changing the approach to learning and teaching putting greater emphasis on digital texts. For the case of digital texts, hypertexts contrast with classical texts as they present a non-linear way of presenting information, where the reader can choose his or her own navigation path during reading (Waniek, 2002). This is accomplished by inserting hyperlinks between different information passages. A hyperlink links one piece of information to another, perhaps on a separate page of the same website, or a different website all together. These hyperlinks allow readers to jump from their current postion within the text to another piece of information about a specific topic, which in turn has implications for the reading process. Most crucially this seems to place strong demands on attentional processes as hyperlinks may disrupt the reading process (Fitzsimmons et al., 2019; Salmerón & García, 2012). Thus, it is conceivable that hyperlinks could affect the demands on the reader with consequences for MW and reading comprehension. The present study sets out to explore these effects of hyperlinks in more detail.

Typically, hypertexts are composed of two organisational units: individual text units, called nodes, that convey the content of the text (similar to a paragraph or page in a book), and the hyperlinks that provide access to and connect these nodes (Storrer, 1999). Furthermore, hyperlinks enable different types of organisation of hypertexts, such as hierarchically organized and networked hypertexts, which in turn influence aspects of text cohesion and text coherence (Gerdes, 1997; Mehler, 2004; Storrer, 1999). Different type of hypertexts with different link types can be distinguished. Hierarchically structured hypertexts consist of central and subordinate nodes and usually include *content links* (Cuddihy et al., 2012; DeStefano & LeFevre, 2007). As can be seen in Fig. A, content links lead to subnodes of content and allow for back-and-forth jumping and they connect different nodes thematically, i.e., they allow for further elaboration of the information about a topic and are usually assigned to coherence planning (Storrer, 2020). They establish a semantic relationship between the content of the nodes (Herrada-Valverde & Herrada-Valverde, 2017). By contrast, in a networked hypertext, all nodes that have a content overlap can be linked to each other without an overall hierarchical structure being apparent (Blom et al., 2018). Networked hypertexts promotes non-sequential reading and usually contain mainly *structural links,* as illustrated in Fig. B. Structural links connect nodes from different areas of the hypertext and have primarily a functional purpose by linking one part of the text to another part independently of the content relation. These links influence the navigation of the text (Herrada-Valverde & Herrada-Valverde, 2017; Storrer, 2020).

With respect to the potential impact of hypertexts on reading performance, previous studies have made rather conflicting claims (Miall & Dobson, 2001; Salmerón & García, 2012). For example, Salmerón and García (2012) showed that reading a hierarchical hypertext supported the integration of information compared to reading a printed text. Miall and Dobson (2001) suggested that participants had difficulty following the content of the narrative and attention was only drawn to surface features of the text compared to participants who read a linear form of the narrative. For the present study, hierarchical and networked hypertexts are of particular interest, as different types of hyperlinks in the different types of hypertext formats represent new possibilities of cohesive devices.

According to Scharinger et al. (2015), hyperlinks could affect both stages of text reading outlined in the construction-integration (CI) model of reading comprehension (Kintsch & van Dijk, 1978). During the first stage (i.e., construction), concepts from the text are activated to produce a network of activated concepts. Scharinger et al. (2015) argue that hyperlinks interrupt the reading process and readers must change their reading task to a hyperlink selection decision. During the second stage (i.e., integration), referred to as the reader's mental representation or situation model, a mental image associated to prior experience is formed. As stated by Scharinger et al. (2015), readers have to follow a hyperlink to continue the reading process and integrate the following node with the just read nodes into a situation model (integration step), (see also DeStefano & LeFevre, 2007; Kintsch, 1988).

Furthermore, Salmerón and García (2012) reported differences between participants with low and high attention span, showing that participants with low sustained attention benefited from reading a hypertext with a hierarchical structure compared to reading a printed text while participants with high sustained attention did not so or to a lesser degree. In a similar vein, individual differences in working memory capacity (WMC) have been consistently demonstrated to be linked to attentional control and the occurrence of MW (in this paper referred to as *task-unrelated thoughts*, TUTs) in cognitively demanding tasks like reading (McVay et al., 2013; McVay, Kane, 2012a, 2012b). Especially during digital reading, WMC is further challenged: when links are built into the hypertext, additional resources are required for the consideration of link selection, but also for the establishment of connections between the nodes. Readers with small WMC are then less able to navigate efficiently through an unstructured text (Shapiro & Niederhauser, 2004) and have less resources to construct a mental representation of the text without additional cognitive load, whereas readers with high WMC have more resources available to construct a mental representation of the text (Amadieu & Salmerón, 2014).

In this study, we aim to address the question whether the type of hypertext (hierarchical or networked) influences attention failures (measured with MW) as well as reading comprehension. For this reason, we compare hierarchical hypertexts and networked hypertexts with their respective hyperlink specifics and investigate their impact on MW during reading and on reading performance.

In more detail, participants in the current study were asked to read a high- or a low-cohesive version with either a hierarchical structure with content hyperlinks or a networked structure with structural hyperlinks of an expository text about the copy right law, with the goal to answer questions assessing reading comprehension. We assessed the occurrence of MW by presenting thought probes asking participants to indicate the occurrence of different types of thoughts during text reading. After text reading, participants answered reading comprehension questions about the text. Based on the assumptions of the *resource-demand matching view* (Schurer et al., 2020), we predicted that a more cohesive structure (high cohesive version with content links/ a hierarchical structure) of a hypertext should be accompanied with a lower amount of MW and an increased reading comprehension compared to a less cohesive structure of a hypertext (low cohesive version with structural links; hypothesis 1). We also hypothesized that reading a demanding hypertext (low cohesion, networked structure with structural hyperlinks) with a lower WMC should be accompanied with a greater amount of MW and a decreased reading comprehension compared to a lower WMC (hypothesis 2). These predictions evolve from the resource-demands matching view because greater WMC and more cohesive text structure should allow for a better matching of the available individual resources to the specific task demands during reading.

2. Methods

2.1. Participants

Participants were 90 students across several courses at the Martin-Luther-University Halle-Wittenberg. Sample-size was determined with the software G*Power (Faul et al., 2007) to detect medium-sized effects ($f = 0.3$) in the predicted directed direction with good statistical power (i.e., 1-β < 0.80). The analysis yielded a required total sample size of $N = 90$ participants. The sample size was further estimated based on effect sizes reported by Schurer et al. (2020) to be approximately $N = 90$ for a between group comparison. Detailed sample characteristics can be found in Table A.

45 participants were in the hierarchical hypertext structure and 45 participants in the networked hypertext structure group. In each group, 27 participants read a high-cohesion version of the hypertext (easy

Table A
Sample characteristics.

	All students $n = 90$
Sex: female (%)	72.20
Age (years)	23.78 0.389
University semester	6.31 ± 10.671
OSpan Score	62.59 ± 10.11
RSpan Score	111.71 ± 10.37
CK score	3.86 ± 0.093
Total reading time (sec.)	1676.78 ± 475.16
Original Sentence (%)	0.674 ± 0.197
Surface manipulations (%)	0.355 ± 0.259
Textbase manipulations (%)	0.753 ± 0.209
False errors (%)	0.563 ± 0.194

OSpan = operation span, RSpan = reading span, CK = content knowledge, values represent means ± *SE*.

condition), and 18 participants read the low-cohesion version of the same hypertext (difficult condition). All participants were between 18 and 33 years old and were native speakers of German. The mean age of the participants was 23.78 years (*SD* = 3.89). The experimental protocol conformed to the declaration of Helsinki and written informed consent was obtained from each participant before the commencement of the study. The study was approved by the ethics committee of the Deutsche Gesellschaft für Psychologie (DGPs). Participants received 12 Euro as compensation for their time.

2.2. Materials and procedure

We adapted the procedure and materials of a previous study by Schurer et al., 2020. The entire study was conducted in a single 1.5-h session, *depending on how quickly participants read.* First, participants were asked to give their approval to participate in the study by reading and signing a statement of informed consent. Participants then provided demographic information including gender, age, study course, and semester. Then, they completed a short content knowledge test to assess their prior knowledge of the content domain, followed by reading a hypertext about the copy right law. Participants were informed that they may take as much time as they need to read through the passages, and that they should use the hyperlinks to navigate through the text. Participants were presented with thought probes to assess MW while reading, answered reading comprehension questions based on the text to assess a basic understanding of the text and took part in a memory test to assess textbase comprehension. Finally, the participants completed two working memory tasks (Ospan and Rspan) to assess their WMC performance.

2.3. Tasks

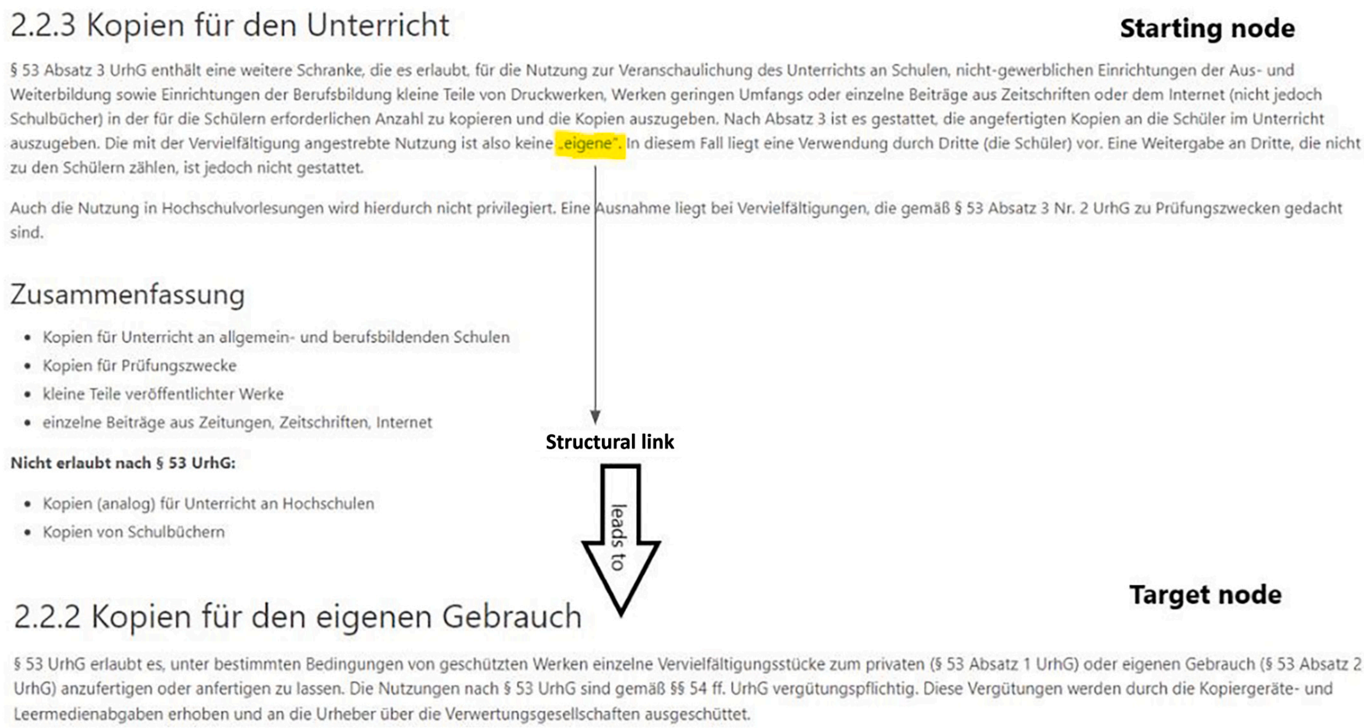
2.3.1. Content knowledge test

Participants completed a paper-pencil content knowledge test with 5 single-choice questions about general copyright law aspects to measure participant's knowledge about the content of the text. For each question, participants had to choose one answer out of four possible alternatives. The correct answers were added together to obtain a total score of prior content knowledge. In the semantic links group, the mean sum of correct answers was *M* = 3.93 (*SD* = 0.963), and in the structural links group *M* = 3.78 (*SD* = 0.902). The questions differed from those that measured reading comprehension.

2.3.2. Hypertext reading

Participants read expository hypertext about the copyright law with

Fig. A. Section of an example node of the hierarchical hypertext version including the target node of the hyperlink (content link)
Note. Excerpt from the experimental text on copyright in German. The highlighted word represents the content link. Content links return to the current node.



2.2.3 Kopien für den Unterricht

§ 53 Absatz 3 UrhG enthält eine weitere Schranke, die es erlaubt, für die Nutzung zur Veranschaulichung des Unterrichts an Schulen, nicht-gewerblichen Einrichtungen der Aus- und Weiterbildung sowie Einrichtungen der Berufsbildung kleine Teile von Druckwerken, Werken geringen Umfangs oder einzelne Beiträge aus Zeitschriften oder dem Internet (nicht jedoch Schulbücher) in der für die Schülern erforderlichen Anzahl zu kopieren und die Kopien auszugeben. Nach Absatz 3 ist es gestattet, die angefertigten Kopien an die Schüler im Unterricht auszugeben. Die mit der Vervielfältigung angestrebte Nutzung ist also keine „eigene". In diesem Fall liegt eine Verwendung durch Dritte (die Schüler) vor. Eine Weitergabe an Dritte, die nicht zu den Schülern zählen, ist jedoch nicht gestattet.

Auch die Nutzung in Hochschulvorlesungen wird hierdurch nicht privilegiert. Eine Ausnahme liegt bei Vervielfältigungen, die gemäß § 53 Absatz 3 Nr. 2 UrhG zu Prüfungszwecken gedacht sind.

Zusammenfassung

- Kopien für Unterricht an allgemein- und berufsbildenden Schulen
- Kopien für Prüfungszwecke
- kleine Teile veröffentlichter Werke
- einzelne Beiträge aus Zeitungen, Zeitschriften, Internet

Nicht erlaubt nach § 53 UrhG:

- Kopien (analog) für Unterricht an Hochschulen
- Kopien von Schulbüchern

2.2.2 Kopien für den eigenen Gebrauch

§ 53 UrhG erlaubt es, unter bestimmten Bedingungen von geschützten Werken einzelne Vervielfältigungsstücke zum privaten (§ 53 Absatz 1 UrhG) oder eigenen Gebrauch (§ 53 Absatz 2 UrhG) anzufertigen oder anfertigen zu lassen. Die Nutzungen nach § 53 UrhG sind gemäß §§ 54 ff. UrhG vergütungspflichtig. Diese Vergütungen werden durch die Kopiergeräte- und Leermedienabgaben erhoben und an die Urheber über die Verwertungsgesellschaften ausgeschüttet.

Fig. B. Section of an example node of the networked hypertext version including the target node of the hyperlink (structural link)
Note. Excerpt from the experimental text on copyright in German. The highlighted word represents the structural link. Structural links connect nodes from different areas of the hypertext and skip nodes.

either high (easy condition) or low (difficult condition) cohesion. We used the same hypertext as Schurer et al. (2020) with a linear structure achieved by using only navigational hyperlinks leading to the next node (e.g., next page). Text difficulty in this text was manipulated by the same cohesion manipulations at local and global level proposed by McNamara and Kintsch (1996). For creating the high-cohesive/easy texts, the following aspects were manipulated: (1) replacing pronouns with noun phrases, when the referent was ambiguous; (2) adding sentence connectives to specify the relations between ideas; and (3) replacing words to increase argument overlap. For creating the low-cohesive/difficult texts, the following actions were conducted: (1) using pronouns instead of noun phrases, especially when the referent was ambiguous; (2) removing sentence connectives to unlink the relations between ideas; and (3) using different words to decrease argument overlap. There were in both the easy and difficult condition 68 manipulations in total. The text slightly differed in length (the highly cohesive version was 4870 words and the length of the low cohesive version was 4620 words), but not in text content or the layout. The average Flesch-Reading-Ease-Score was 50 in the easy (indicating moderate difficulty) and 38 in the difficult condition (indicating difficulty; Schöll, 2015).

For the present study both the easy and difficult versions of the linear text (Schurer et al., 2020) were restructured to build a hierarchical hypertext version and a networked hypertext version. Thus, the same content was presented by including hyperlinks as new cohesive devices in both hypertexts. Consequently, networked hypertexts contain structural hyperlinks to maximize the contrast to the hierarchical content hyperlinks. The networked hypertext with structural hyperlinks provided a cross-reference from a certain keyword to other pages – the linking words were generally nouns selected on the basis of overlapping content in other nodes. Structural hyperlinks were embedded in the middle of the text body and led to a different node of the hypertext, which contained a related concept/argument. For example, in the excerpt shown in Fig. B, the link indicator "eigene" is found in the middle of the text body of subchapter 2.2.3 leads back to the target node of subchapter 2.2.2, elaborating on a related concept. In contrast, hierarchical hypertext with content hyperlinks revealed optional further information on the same topic to deepen understanding and readers always returned to the origin of the hyperlink providing a fixed order for exploring the content. Content hyperlinks, like the "Summary" link indicator in the excerpt shown in Fig. A, were always embedded at the end of a section and opened a target node at the same page providing a summary of the node's content. The content in both versions was identical, they only differed in the underlying hypertext structure and their hyperlink type between the nodes. All hypertext versions were displayed on a computer screen in black on a white background across several pages with one page contained about 500 words. Every hypertext version contained 26 hyperlinks of which 14 hyperlinks were required to navigate the text and, thus, identical in all versions of the hypertext and further 12 hyperlinks were content/structural with 0 to 3 hyperlinks per node. The starting page was the same in every hypertext version and gave an overview of the text structure and offered the first three chapters of the text to begin reading (see Figs. A, B).

Readers could freely jump between pages to explore the content in their own order. Thus, navigation paths to explore the entire text could differ between individuals. Participants were instructed to simply read through the texts and to select the hyperlinks they wished and were given as much time as they needed to read the text. They were also informed before reading that they should conduct a reading comprehension test after the reading process.

2.3.3. *Mind wandering probes*

To test participants' attention focussing on the text and other contents, we measured potential MW. For that purpose, participants, initially, were presented with an instruction, which contained a definition of MW, which is based on Smallwood and Schooler's (2006) definition and includes similar categorizations MW episodes as McVay, Kane (2012b). During reading the hypertexts, participants were asked at intervals, which varied randomly between 2 and 4 min with an average duration of 3 min, what they were thinking about immediately before a thought probe appeared. This question appeared in a pop-up window at the bottom of the screen with a beep (Stawarczyk et al., 2011; Unsworth & McMillan, 2013). With the appearance of the thought probe, participants had to select an answer from four answer categories by pressing the corresponding number on their keyboard: (1) thoughts directed on the text content; (2) how well I understand the text; (3) the current state of being; (4) a memory in the past or something in the future (Unsworth & McMillan, 2013). After responding to a category, the participants continued reading the text. We recorded reading times for the entire hypertext.

2.3.4. Reading comprehension test

To test reading comprehension, participants completed a paper pencil reading comprehension task with a total of 12 single-choice questions structure (see Schurer et al., 2020 for details). Each question contained four possible answers, from which the participants had to choose one. During this task, the participants had no access to the hypertext. The results were the sum of the correctly answered questions.

2.3.5. Memory test

In the memory test, participants had to decide whether a sentence presented on a screen appeared in the hypertext or not. There were 16 sentences in total. 8 sentences were original text sentences and 8 sentences were manipulated either on surface or textbase structure (see Schurer et al., 2020 for details). Manipulations on surface structure contained the shifting of a clause within the base sentence to a new position, so that the surface sentence structure changed, whereas manipulations on textbase structure contained the replacing of a proposition in the base sentence, so that the meaning of the text altered (see Schurer et al., 2020 for details). For statistical analyses, we analysed the percentage of correct answers.

2.3.6. Working memory capacity tasks

Participants completed two complex span tasks (operation span and reading span) to assess individual WMC performance. We calculated the total value for the memory span as the mean proportions of the correct responses from the two tasks (see Schurer et al., 2020 for details). A median split of the sample according to the composite score of WMC was carried out to split the participants into two groups: High-WMC and low-WMC. In the easy text condition, 24 participants showed a low-WMC (12 in the hierarchical hypertext group, 12 in the networked hypertext group), and 27 participants showed a high-WMC (15 in the hierarchical hypertext group, 12 in the networked hypertext group). In the difficult text condition, 18 partcipants showed a low-WMC (9 in the hierarchical hypertext group, 9 in the networked hypertext group), and 17 participants showed a high-WMC (8 in the hierarchical hypertext group, 9 in the networked hypertext group). We choose the median-split-based analysis of the WMC differences as our main approach in order to allow for best comparison of the current findings with those of an earlier study, in which we investigated the potential of WMC difference with a similar manipulation (Schurer et al., 2020; for a similar procedure see Klatt & Smeeton, 2021 or Sörqvist et al., 2012). One might argue that the distinction between high and low WMC participants by using median might be arbitrary (e.g. Vargha et al., 1996). Therefore, in addition, we treated WMC as a continuous variable in an additional analysis, the results of which are reported in the Appendix A.

2.4. Statistical analyses

All statistical analyses were carried out using IBM SPSS Statistics 25.0. An alpha value of 0.05 was adopted for all significance testing. Estimated effect sizes are reported using partial eta squared (η_p^2). Post-hoc tests were adjusted using Bonferroni correction. Analyses of variance (ANOVAs), and paired *t*-tests were conducted for the analyses of MW, and reading comprehension performances. In a first analysis, we examined potential influencing factors on MW and conducted a three-way ANOVA to analyse the interaction of hypertext structure group, text difficulty, and WMC. In a next step, we conducted separate paired *t*-tests to analyse the potential impact of the factors on MW. In a second analysis, we conducted a three-way ANOVA to analyse the interaction of hypertext structure group, text difficulty, and WMC on reading comprehension. In a next step, we conducted separate paired t-tests to analyse the potential impact of the factors on MW. As additional analyses, we conducted ANCOVAs for the relevant analyses (see Appendix A/Footnotes) to additionally control for potential differences in working memory capacity and its potential effects on MW rates and reading comprehension. In that analyses, we treated the WMC as covariate and as a continuous variable and the factors text difficulty and hypertext group as main factors. We represent the main findings of this analyses in the Appendix A and included footnotes in which we point to potential differences in the outcomes of the analyses. Means and standard errors are presented in Table A.

3. Results

3.1. First analysis: effects on mind wandering

Looking at the mean proportion of MW episodes across the four text conditions, participants experienced the highest amount of overall TUTs (37 %) when reading difficult (to read) hypertexts with networked link structure and the lowest amount of overall TUTs when reading easy hypertexts with both a networked and a hierarchical structure (23 %, see Table B).

A three-way ANOVA was run to examine the effect of text difficulty, hypertext structure and WMC on TUTs. The analysis of overall TUTs demonstrated a significant main effect of hypertext structure [$F_{(1, 80)} = 4.093$, $p = .046$, $\eta^2 = 0.049$]. Participants who read the networked hypertext showed significantly more TUTs than participants who read the hierarchical hypertext. Results indicated that no significant main effect of text difficulty or WMC existed [all $ps > 0.05$]. However, we could find a significant interaction between hypertext structure and WMC on overall TUTs [$F_{(1, 80)} = 4.261$, $p = .042$, $\eta^2 = 0.051$, see Fig. C].[1]

No other significant interactions were obtained. We conducted post-hoc analyses in order to compare hypertext structure effects separately

Table B
Mean proportion of mind wandering, and comprehension scores for semantic links and structural links groups and for both groups combined.

Measure	Hierarchical hypertext group	Networked hypertext group	Both groups
Thought probes			
Task Related Thoughts (TRTs)	0.76 (0.23)	0.70 (0.18)	0.72 (0.21)
Text	0.45 (0.22)	0.48 (0.25)	0.45 (0.23)
Text-related thoughts	0.31 (0.17)	0.22 (0.16)	0.27 (0.17)
Task unrelated thoughts (TUTs)	0.24 (0.18)	0.30 (0.18)	0.28 (0.18)
Current state of being	0.14 (0.12)	0.19 (0.14)	0.18 (0.13)
Something in the past/future	0.10 (0.12)	0.11 (0.12)	0.10 (12)
Comprehension			
Reading comprehension score	7.36 (1.37)	6.82 (1.96)	7.09 (1.70)

TRTs = task-related thoughts, TUTs = task-unrelated thoughts, values represent means ± *SE*.

[1] An additional ANCOVA, in which WMC was treated as a covariate, was performed. The ANCOVA did not show any fundamentally different results compared to the ANOVA (see Appendix, Table C).

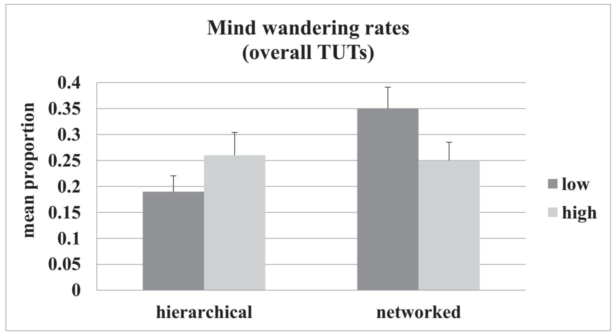


Fig. C. Mean proportion of overall TUTs in the different hypertext structure conditions for low and high WMC participants. TUT = task unrelated thoughts.

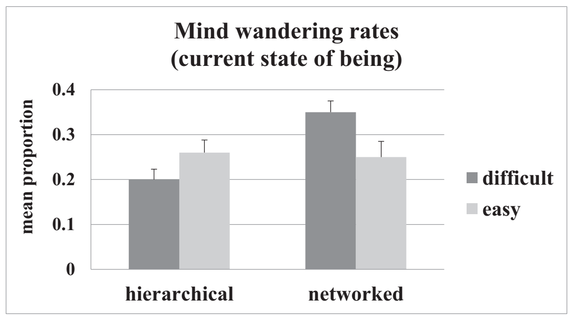


Fig. D. Mean proportion of TUTs category "current state of being" in the different hypertext structure conditions for easy and difficult texts. TUT = task unrelated thoughts.

for lower and higher WMC participants. We observed a significant difference between the two versions of hypertext structure for participants with a lower WMC [$t_{(41)} = -2.984$, $p = .005$], but not for participants with a higher WMC [$t_{(43)} = 0.188$, $p > .05$]. As can be seen in Fig. C, participants reading a networked hypertext showed more TUTs compared to reading the hierarchical hypertext only under condition of a low WMC but not of high WMC.

Furthermore, we could find a significant main effect of hypertext structure on TUTs category *current state of being*, [$F_{(1,\ 80)} = 8.259$, $p = .005$, $\eta^2 = 0.094$], as well as a significant main effect of text difficulty on *current state of being* [$F_{(1,\ 80)} = 12.605$, $p = .001$, $\eta^2 = 0.136$]. Participants who read the networked hypertext as well as participants who read the difficult text version showed significantly more TUTs concering their current state of being than participants who read the hierarchical hypertext or who read the easy version of the text. In addition, we did observe a significant interaction between hypertext structure and text difficulty on TUTs concerning the *current state of being*, [$F(_{1,\ 80}) = 8.866$, $p = .004$, $\eta^2 = 0.100$; see Fig. D].[2]

Post-hoc analyses were conducted to compare hypertext structure effects separately for easy and difficult text condition. We could find a significant difference comparing hypertext structure effects for the difficult [$t_{(18)} = -4.152$, $p = .000$], but not for the easy text condition [$t_{(27)} = 0.217$, $p > .05$] indicating that participants reading a difficult (to read) hypertext with networked link structure showed more TUTs (see Fig. D) compared to reading the easy to read version.

In addition, we could find a marginally significant interaction between hypertext structure, text difficulty and WMC [$F_{(1,\ 80)} = 3.535$, $p = .064$, $\eta^2 = 0.042$]. Due to the marginal interaction, we looked at the effect separately for the low and high WMC group. For the low WMC group there was a significant main effect of hypertext structure [$F_{(1,42)} = 5.569$, $p = .023$, $\eta^2 = 0.125$] and text difficulty [$F_{(1,42)} = 8.042$, $p = .007$, $\eta^2 = 0.171$] on TUTs about the *current state of being*, but no significant interaction of both factors. Participants reading the difficult text showed more TUTs than participants reading the easy text. Similarly, more TUTs about the *current state of being* were observed in participants reading the networked hypertext compared to the hierarchical hypertext. In the high WMC group, there was a significant main effect of text difficulty [$F_{(1,44)} = 4.916$, $p = .032$, $\eta^2 = 0.107$] on TUTs about the *current state of being* as well as a significant interaction between hypertext structure and text difficulty [$F_{(1,44)} = 10.874$, $p = .002$, $\eta^2 = 0.210$] (see Table B). With respect to the TUTs category *something in the past/future*, we could not find any significant main effects or interactions on the TUTs [all *ps* > 0.05]. Additional ANCOVA results showed similar results (see Appendix A/Footnotes).

3.2. Second analysis: effects on reading comprehension

In general, it should be said that overall reading times (in seconds) of the difficult texts [$M = 1628$, $SD = 0.520$] was not statistically different from the overall reading times of the easy texts [$M = 1709$, $SD = 0.445$; $t_{(88)} = 0.788$, $p = .433$]. In adddition, the overall reading times in the hierarchical hypertexts group [$M = 1740$, $SD = 0.478$] was not statistically different from the overall reading times in the networked hypertext group [$M = 1613$, $SD = 0.469$; $t_{(88)} = 1.267$, $p = .208$]. This indicates that neither text difficulty nor the hypertext structure had an effect on reading times.

Reading comprehension was on the one side measured with a reading comprehension test. As can be seen in Table B, the participants reading the hypertext in a networked structure yielded lower reading comprehension scores compared to participants reading the hypertext in a hierarchical structure. A three-way ANOVA was conducted to examine the effect of text difficulty, hypertext structure and WMC on reading comprehension. The results revealed a significant main effect of hypertext structure [$F(_{1,\ 80}) = 3.953$, $p = .050$, $\eta^2 = 0.047$] with lower reading comprehension scores observed after reading the hypertext with

[2] An additional ANCOVA, in which WMC was treated as a covariate, was performed. The ANCOVA did not show any fundamentally different results compared to the ANOVA (see Appendix, Table D).

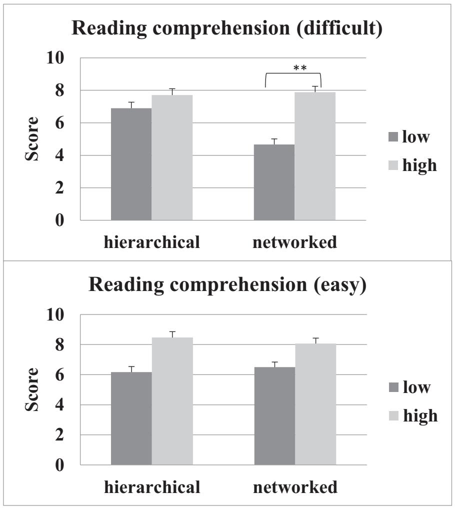


Fig. E. Mean reading comprehension score depending on hypertext structure conditions, WMC (low and high) of the participants, and text difficulty.
Note. Scores were the sum of correctly answered questions (12 single-choice questions).

a networked structure compared to the hypertext with a hierarchical structure. In addition, the main effect of WMC [$F(1,\ 80) = 42.915$, $p = .000$, $\eta^2 = 0.349$] on reading comprehension, with high WMC participants yielding higher reading comprehension scores compared to participants with a low WMC. No main effect of text difficulty [$p > .05$] on reading comprehension was found. Furthermore, we found a triple interaction between hypertext structure, text difficulty and WMC on reading comprehension, [$F(1,\ 80) = 8.140$, $p = .006$, $\eta^2 = 0.092$]. We then conducted a 2 × 2 ANOVA separately for the easy and the difficult text condition participants to investigate whether there was a difference between the reading comprehension scores when participants read a hypertext with a hierarchical or networked link structure between the different text difficulty options. The analysis showed that participants with a low WMC yielded a significantly lower score [$M = 4.67$, $SD = 1.00$] when reading a difficult text in a networked structure than participants with a high WMC [$M = 7.89$, $SD = 1.83$; $F(1,\ 17) = 31.135$, $p = .000$, $\eta^2 = 0.647$] (see Fig. E).[3]

However, there was no significant difference in comprehension between low and high WMC participants after reading the difficult (to read) hypertext with hierarchical link structure [$p > .05$]. In addition, there was no significant difference between the easy (to read) hypertext with networked and hierarchicallink structure for low and high WMC participants [$p > .05$].

We also assessed memory for the text. Participants reading the hierarchical hypertext recognized 35 % of the surface manipulations correctly while those reading the networked hypertext correctly recognized 36 % of the surface manipulations. Participants reading the networked hypertext correctly recognized less textbase manipulations (72 %) than participants reading the hierarchical hypertext (79 %). We conducted a three-way ANOVA to analyse the influence of text difficulty, hypertext structure and WMC on correctly recognized surface and textbase manipulations. While there was no significant main effect of text difficulty [$p > .05$] on the correct recognition of textbase manipulations, a significant main effect of hypertext structure [$F_{(1,78)} = 3.934$, $p = .051$ $\eta^2 = 0.048$], and WMC [$F_{(1,78)} = 11.368$, $p = .001$, $\eta^2 = 0.127$] was found. Participants who read the networked hypertext correctly recgonized less textbase manipulations than participants who read the hierarchical hypertext. In addition, participants with a lower WMC correctly recgonized less textbase manipulations than with a greater WMC. No significant interaction was found [all $ps > 0.05$]. We could not find any significant main effects or interactions for correctly recognized surface manipulations [all $ps > 0.05$].

3.3. Relationship between mind wandering and reading comprehension

In order to assess the relationship between the amount of TUTs, and reading performance, we conducted a Pearson‘s correlation analysis between the related values across all participants. We observed a significant negative correlation between overall TUTs, and reading comprehension score [$r\ (88) = -0.242$, $p = .022$] suggesting that participants with more TUTs showed less correct reading performance. Crucially, this correlation between overall TUTs and reading comprehension was mainly driven by participants with low WMC as indicated by a significant negative correlation between overall TUTs and reading comprehension [$r\ (41) = -0.490$. $p = .001$] for participants with low WMC but not for participants with high WMC.

Additional ANCOVA analyses (see Appendix A, Table E) corroborated these previous statements to a large extend. However, with regard to reading comprehension, there were deviations in significance concerning the main effect of the hypertext group as well as the significant triple interaction between hypertext group, text difficulty and WMC. However, with regard to comparability with previous studies (see Schurer et al., 2020), we rely on the ANOVA results at this point.

4. Discussion

The aim of the present study was to investigate the influence of different hyperlink structures in online texts on the attention distribution and the comprehension performance of readers. For that purpose, we tested MW (TUTs) and reading performance in four groups of participants exposed to hypertexts about the copyright law differing in the cohesion level and link/hypertext structure. We predicted that a difficult text to read with a low-WMC and with a networked hypertext structure compared to an easy text to read with a high WMC and with a hierarchical hypertext to be accompanied with a larger amount of TUTs. Specifically, we hypothesized that reading a more demanding hypertext would lead to more TUTs and that less available cognitive resources would then lead to more TUTs and a less degree of reading comprehension.

4.1. Mind wandering

We hypothesized that MW (TUTs) would be influenced by an interaction of three factors: hypertext structure (hierarchical vs. networked), WMC (low vs. high) x difficulty (easy vs. difficult). We further assumed more TUTs for participants reading the more demanding versions and with lower WMC, since participants with greater WMC have more cognitive resources available to cope with the demands imposed by increased text difficulty and a networked hypertext structure. As expected, participants in the networked hypertext group showed more overall TUTs and TUTs regarding the *current state of being* than participants in the hierarchical hypertext group. We could not find the same effect for the TUTs category *something in the past/future*. This is in good agreement with earlier assumptions that *current state of being* experiences are mainly responsible for MW episodes (McVay & Kane, 2009; Stawarczyk et al., 2014). Nevertheless, we could not find a triple interaction between hypertext structure, text difficulty and WMC on overall TUTs. However, we found a significant interaction between hypertext structure and WMC on overall TUTs, and a significant interaction between hypertext structure and text difficulty on the TUTs category of *current state of being*. With a networked link structure, the

[3] An additional ANCOVA, in which WMC was treated as a covariate, was performed. The ANCOVA showed deviations of the results from the ANOVA with respect to the significant main effect of the hypertext group as well as the significant triple interaction between hypertext group, text difficulty and WMC (see Appendix, Table E).

reader could experience orientational problem in such an open structure, and the reader puts the hypertext nodes together in an individual way, i.e., in such a way that the hypertext would be convenient for him/her to read. As a result, participants could experience more TUTs, especially when WMC is very low or there is an additional demand in the form of increased text difficulty. In addition, we found a significant main effect of hypertext structure and text difficulty on TUTs (*current state of being*), which indicates that both factors independently lead to more TUTs. The content links in hierarchical hypertexts connected nodes thematically, resulting in a coherent representation of the text (Storrer, 2020), whereas the structural links in networked hypertexts had no thematic connection. Therefore, the results for the condition of reading networked hypertext suggest that the integration step failed and participants were unable to build a situation model of the text they were reading (Kintsch & van Dijk, 1978; Scharinger et al., 2015). In particular, reading a difficult text in a networked structure increased the demands for the reader in a way that building a mental representation of the text failed and more TUTs occurred. This has then further compromised by a low WMC. Furthermore, participants with high WMC experience more TUTs when reading the easy (to read) hypertext with hierarchical link structure compared to when reading the difficult (to read) hypertext with networked link structure, which suggests that these participants are bored when the reading demands are less demanding, which leads to an increase in TUTs. The lower comprehension scores alongside higher rates of MW in the networked, and thus less cohesive hypertext version suggest that readers' ability to construct a situation model from the text is impaired. In line with the present results, this would imply that participants have no resources available to suppress TUTs. Furthermore, this pattern was modulated by WMC; participants with low WMC exhibited more MW and lower comprehension in the networked hypertext compared to the hierarchichal hypertext than participants with high WMC. This interaction could be partly explained by previous findings demonstrating that in situations where cognitive demands are low, WMC and frequency of MW are unrelated because individuals with high WMC do not need to fully focus on the task to perform well (see Rummel & Boywitt, 2014). However, Rummel and Boywitt (2014) also report more TUTs for the easy compared to a more difficult version of their task which contradicts the present findings. However, the present results are in accordance with the *resource-demand-matching view* of our group (Schurer et al., 2020; Schurer et al., 2022), and suggests that an increase of the task demands as in the networked hypertext in combination with low availability of cognitive resources, i.e., for participants with low WMC, leads to more MW. With a high WMC, fewer TUTs show up with structural links in the networked hypertext structure due to the resources available, while participants with low WMC cannot cope with the nature of the hyperlinks and they therefore drop out more quickly with increasing difficulty (difficult text). Also, the observation of a significant negative correlation between reading comprehension and TUTs for participants with low WMC supports our model, because it is consistent with the assumption that TUTs occurring in situations in which the task demands exceed the available resources should lead to impaired task performance. Such correlations were not found for the high WMC group, suggesting that low and high WMC participants generate different TUTs. An increase in TUTs in the low WMC group leads to less knowledge, suggesting a loss of control over TUTs, whereas high WMC participants can experience TUTs without learning performance being affected because the demands are too low. This is particularly pronounced in the networked hypertext group but not in the hierarchical hyperlinks group. The *resource-demand-matching view* proposes, MW as a resource demanding process depending on the underlying interaction of resources and demands of tasks; this would explain why in the current study participants showed higher TUTs rates when their cognitive resources fall below the task demands in the difficult (to read) hypertext with networked link structure. By this the *resource-demand-matching view* can be considered an extension of previous accounts but further exploration is required to understand the conditions under which MW can or will occur.

One previously published study (Schurer et al., 2020) using the same hypertexts but without the additional links of the present study revealed similar results in the earlier studies with the present one in terms of MW and text comprehension as those results observed in this study. When considering these as control groups for the present study it could be inferred that it is not the inclusion of hyperlinks per se but rather the organisation of the hypertext links that has caused the differences in MW and reading comprehension between the different hypertext versions in the current study. Although, an increased number of TUTs and reduced reading comprehension performance suggest that the networked hypertexts are more difficult than hierarchical hypertexts, some alternative influences cannot completely be excluded on the basis of the current results. Nevertheless, since there was no independent control group without any hypertext links in this study, the results should be interpreted with some caution. It is not entirely clear to what extent the results are driven by the organisation of the hypertext per se, or whether the inclusion of hypertext links inadvertently influences perceptual difficulty, difficulty in terms of cohesion/coherence or fluency across conditions.

4.2. Reading comprehension

We further hypothesized that reading comprehension would be influenced by an interaction of three factors: hypertext structure (hierarchical vs. networked), WMC (low vs. high) and difficulty (easy vs. difficult). We assumed less reading comprehension for participants with lower WMC, since participants with high WMC have more cognitive resources available to cope with the increased demands. When looking at the results descriptively, it turns out that participants reading the hierarchical hypertext with content hyperlinks showed a better reading comprehension score than participants reading the networked hypertext with structural hyperlinks. This is consistent with previous studies, which showed that increasing the cohesion of a text with classical cohesive devices helps to construct a situation model of the text and therefore facilitates and improves reading comprehension for readers (Graesser & McNamara, 2011; McNamara et al., 1996). We found a triple interaction between hypertext structure, text difficulty and WMC on reading comprehension score. Participants with low WMC showed worse reading comprehension performance when reading a difficult (to read) hypertext with networked link structure than participants with high WMC. This is consistent with previous studies and supports the assumption that increasing the cohesion of a text helps to construct a situation model of the text and therefore facilitates and improves reading comprehension (Graesser & McNamara, 2011; McNamara et al., 1996). In addition, lower WMC participants might have difficulties to inhibit irrelevant information and access related information from working memory, especially when text complexity is high. Hyperlinks as cohesive cues can therefore also have an impact in improving reading comprehension (Scharinger et al., 2015; Storrer, 1999). We could not detect any differences with regard to the hyperlink structure in the easy text version. One possible reason for this observation could be that the current participants were students and, therefore, had sufficient experience with digital technologies. In addition, it can be assumed that younger generations, through early experiences with digital devices, will achieve equivalent or even better levels of comprehension when reading digital texts than when reading on paper (Childwise, 2017). Age differences or digital text experiences should also be taken into account when designing future studies. In addition, we found a significant main effect of hypertext structure and WMC on correctly recognized textbase manipulations, but no significant interaction. Similar observations were absent for correctly recognized surface manipulations. Furthermore, the present results suggest another factor that influences the relationship between the amount of TUTs and reading comprehension. The frequency of overall TUTs and thinking about the *current state of being* was negatively correlated with the reading comprehension score and correctly recognized textbase manipulations for participants with low WMC. While suggesting a close relation between attention focussing and reading, this observation is also important for applied research, because it shows that even under conditions of low available resources a more focussed elaboration of the text is accompanied by less distraction and better reading performance. Although the texts objectively differed in text difficulty, we could not observe differences in reading times between the text types. This is why both coherence and hypertext organisation could also have an effect on fluency. Furthermore, a possible explanation for the lack of a direct effect of text difficulty on text comprehension could be that MW mediated the relationship between disfluency and text comprehension, suggesting that disfluency has an indirect positive effect on comprehension by increasing attentional resources for the reading task (see also Faber et al., 2017). However, the sample size of the current study is not large enough in order to test corresponding complex models that assume indirect and compensatory mutual factorial influences in a sufficiently reliable way (see Fritz & Mackinnon, 2007; Koopman et al., 2015).

5. Limitations

Although the present results in comparison to the results of our previous study using a linear version of the same hypertext suggest that different organisation of hypertexts by means of hyperlinks affects MW and reading comprehension, we admit that caution is necessary when attributing these effects exclusively to the particular hypertext link organisation as realized in the current study. Although many observations point to an influence of the particular organisation of the hyperlinks on reading comprehension and MW, it is possible that factors like perceptual difficulty or fluency play an additional role for the observed effects.

Furthermore, we would like to mention that our assessment of text memory and text comprehension might tap at rather superficial levels of text understanding, thereby limiting the conclusions regarding reading comprehension. Future studies might apply more elaborated measures to infer about deeper levels of text comprehension and its relation to the occurrence of MW, for example, by analysing in more detail participants' reading performance and behavior with eye tracking and special reading time measures at defined text places requiring inferential processing in order to fill in local or global text coherence gaps (Kintsch & van Dijk, 1978). Such analyses might allow for more elaborated conclusions about the impact of MW for the construction of text intergration models during reading performance, which might be hampered especially at those text places that require more far reaching inferences about the relations between different text contents and that are affected by MW episodes. The current study has opened a perspective for such further analyses.

6. Conclusion

The present findings provide important insights into processing attention during reading hypertexts by investigating the interaction of text difficulty (cohesion), hypertext structure, and WMC on MW and reading comprehension while reading digital texts. The study provided evidence that the structure of hypertexts has a strong impact on MW and reading comprehension of readers, especially if the available resources are low. Therefore, the design of hypertexts is important for the conception of web pages, if the aim is to stimulate learning processes with the available content. The current findings have also implications for the theoretical understanding of the operation of attention distraction during text reading. They allow for an extension of existing theories (i.e., the *resource-demand theory, control-failure hypothesis*) by new aspects such as hypertext structure. The *resource-demand-matching view* should be further investigated in future studies on online reading, particularly to establish differences and similarities among the various theoretical assumptions about MW (McVay & Kane, 2010; Rummel & Boywitt, 2014; Smallwood & Schooler, 2006). Furthermore, future studies should investigate the influence of reading hypertext compared to reading printed text assuming the *resource-demand-matching view* and use further elaborative manipulations of text difficulty, to see if a similar data pattern emerges for high WMC readers as for low WMC readers. Especially the deliberate distraction of the reading process, e.g. by pop-up windows or messenger messages that pop up when reading, should be of further interest for future studies on hypertext reading.

Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

All datasets generated for this study are included in the article/Supplementary material.

Acknowledgements

We thank Melanie Müller, Antonia Küttner, Jost Eisenmenger, and Laura Petermann for supporting the data collection.

Funding

TSchur and BO were supported by a Grant of the German Federal Ministry of Research and Education, No. 01PL17065, Quality Pact for Teaching (Qualitätspakt Lehre).

Ethics statement

The study was approved by the ethics committee of the Deutsche Gesellschaft für Psychologie (DGPs). The experimental protocol conformed to the declaration of Helsinki and written informed consent was obtained from each participant before the commencement of the study. After being informed about the experiment, the subjects gave their consent in written form.

Appendix A

Table C
Analysis of Covariance (ANCOVA) summary table for overall TUTs.

Source	SS	df	*F*	*p*	η^2
TotalSpan	99.699	1	0.315	0.576	0.004
TextDifficulty	739.630	1	2.334	0.130	0.027
Hypertext Type	1456.748	1	4.598	0.035*	0.051
TextDifficulty* Hypertext Type	849.638	1	2.682	0.105	0.031
Error		85			
Total		90			

SS sum of squares, $R^2 = 0.057$.
Note. Dependent variable: overall TUTs/percentage.
Note. * indicates statistical significance at 0.05 alpha level.

Table D
Analysis of Covariance (ANCOVA) summary table for TUTs category "current state of being".

Source	SS	df	*F*	*p*	η^2
TotalSpan	0.000	1	0.012	0.913	0.000
TextDifficulty	0.183	1	12.896	0.001*	0.132
Hypertext Type	0.108	1	7.618	0.007*	0.082
TextDifficulty* Hypertext Type	0.135	1	9.530	0.003*	0.101
Error		85			
Total		90			

SS sum of squares, $R^2 = 0.210$.
Note. Dependent variable: TUTs-current state of being/percentage.
Note. * indicates statistical significance at 0.05 alpha level.

Table E
Analysis of Covariance (ANCOVA) summary table for reading comprehension score.

Source	SS	df	*F*	*p*	η^2
TotalSpan	86.510	1	47.455	0.000*	0.358
TextDifficulty	2.472	1	1.356	0.247	0.016
Hypertext Type	2.355	1	1.292	0.259	0.015
TextDifficulty* Hypertext Type	2.985	1	1.637	0.204	0.019
Error		85			
Total		90			

SS sum of squares, $R^2 = 0.369$.
Note. Dependent variable: reading comprehension.
Note. * indicates statistical significance at 0.05 alpha level.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2023.103836.

References

Amadieu, F., & Salmerón, L. (2014). Concept maps for comprehension and navigation of hypertexts. In D. Ifenthaler, & R. Hanewald (Eds.), *Digital knowledge maps in education: Technology-enhanced support for teachers and learners* (pp. 41–59). Springer Science + Business Media. https://doi.org/10.1007/978-1-4614-3178-7_3.

Blom, H., Segers, E., Knoors, H., Hermans, D., & Verhoeven, L. (2018). Comprehension and navigation of networked hypertexts. *Journal of Computer Assisted Learning, 34*, 06–314. https://doi.org/10.1111/jcal.12243

Childwise. (2017). *The monitor trends report.* Retrieved from. Childwise http://www.childwise.co.uk/reports.html#trendsreport. (Accessed 6 March 2021).

Cuddihy, E., Mobrand, K. A., & Spyridakis, J. H. (2012). Web page previews: Effect on comprehension, user perceptions, and site exploration. *Journal of Information Science, 38*(2), 103–117. https://doi.org/10.1177/0165551512437515

DeStefano, D., & LeFevre, J. A. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior, 23*, 1616–1641. https://doi.org/10.1016/j.chb.2005.08.012

Faber, M., Mills, C., Kopp, K., & D'Mello, S. (2017). The effect of disfluency on mind wandering during text comprehension. *Psychonomic Bulletin & Review, 24*(3), 914–919. https://doi.org/10.3758/s13423-016-1153-z

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175–191. https://doi.org/10.3758/BF03193146

Feng, S., D'Mello, S., & Graesser, A. C. (2013). Mind wandering while reading easy and difficult texts. *Psychonomic Bulletin & Review, 20*(3), 586–592. https://doi.org/10.3758/s13423-012-0367-y

Fitzsimmons, G., Weal, M. J., & Drieghe, D. (2019). The impact of hyperlinks on reading text. *PloS One, 14*(2), Article e0210900. https://doi.org/10.1371/journal.pone.0210900

Forrin, N. D., Risko, E. F., & Smilek, D. (2019). On the relation between reading difficulty and mind-wandering: A section-length account. *Psychological Research, 83*(3), 485–497. https://doi.org/10.1007/s00426-017-0936-9

Fritz, M. S., & Mackinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Gerdes, H. (1997). *Lernen mit text und hypertext.* Pabst Science Publishers.

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

Herrada-Valverde, G., & Herrada-Valverde, R. I. (2017). Factors influencing hypertext reading comprehension. *Ocnos. Revista De Estudios Sobre Lectura, 16*(2), 7–16. https://doi.org/10.18239/ocnos_2017.16.2.1287

Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review, 95*(2), 163–182. https://doi.org/10.1037/0033-295X.95.2.163

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review, 85*(5), 363–394. https://doi.org/10.1037/0033-295X.85.5.363

Klatt, S., & Smeeton, N. J. (2021). Spatial separation and working memory capacity affect selective visual attention in the periphery. *Frontiers in Psychology, 12*, Article 692963. https://doi.org/10.3389/fpsyg.2021.692963

Koopman, J., Howe, M., Hollenbeck, J. R., & Sin, H. P. (2015). Small sample mediation testing: Misplaced confidence in bootstrapped confidence intervals. *The Journal of Applied Psychology, 100*(1), 194–202. https://doi.org/10.1037/a0036635

McNamara, D. S., Kintsch, E., Songer, N. B., & Kintsch, W. (1996). Are good texts always better? Interactions of text coherence, background knowledge, and levels of understanding in learning from text. *Cognition and Instruction, 14*(1), 1–43. https://doi.org/10.1207/s1532690xci1401_1

McNamara, D. S., & Kintsch, W. (1996). Learning from texts: Effects of prior knowledge and text coherence. *Discourse Processes, 22*(3), 247–288. https://doi.org/10.1080/01638539609544975

McVay, J. C., & Kane, M. J. (2009). Conducting the train of thought: Working memory capacity, goal neglect, and mind wandering in an executive-control task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*(1), 196–204. https://doi.org/10.1037/a0014104

McVay, J. C., & Kane, M. J. (2010). Does mind wandering reflect executive function or executive failure? Comment on Smallwood and Schooler (2006) and Watkins (2008). *Psychological Bulletin, 136*(2), 188–197. https://doi.org/10.1037/a0018298

McVay, J. C., & Kane, M. J. (2012a). Drifting from slow to "D'oh!": Working memory capacity and mind wandering predict extreme reaction times and executive control errors. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 38*, 525–549. https://doi.org/10.1037/a002589610.3758/PBR.16.5.857

McVay, J. C., & Kane, M. J. (2012b). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and

executive attention. *Journal of Experimental Psychology: General, 141*(2), 302–320. https://doi.org/10.1037/a0025250
McVay, J. C., Meier, M. E., Touron, D. R., & Kane, M. J. (2013). Aging ebbs the flow of thought: Adult age differences in mind wandering, executive control, and self-evaluation. *Acta Psychologica, 142*(1), 136–147. https://doi.org/10.1016/j.actpsy.2012.11.006
Mehler, A. (2004). Automatische synthese internet-basierter links für digitale bibliotheken. *Osnabrücker Beiträge zur Sprachtheorie OBST, 68*, 31–53.
Miall, D. S., & Dobson, T. (2001). Reading hypertext and the experience of literature. *Journal of Digital Information, 2*(1).
Mills, C., Graesser, A., Risko, E. F., & D'Mello, S. K. (2017). Cognitive coupling during reading. *Journal of Experimental Psychology, 146*, 872–883. https://doi.org/10.1037/xge0000309
Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science, 24*(5), 776–781. https://doi.org/10.1177/0956797612459659
Reichle, E. D., Reineberg, A. E., & Schooler, J. W. (2010). Eye movements during mindless reading. *Psychological Science, 21*(9), 1300–1310. https://doi.org/10.1177/0956797610378686
Rummel, J., & Boywitt, C. D. (2014). Controlling the stream of thought: Working memory capacity predicts adjustment of mind-wandering to situational demands. *Psychonomic Bulletin & Review, 21*(5), 1309–1315. https://doi.org/10.3758/s13423-013-0580-3
Salmerón, L., & García, V. (2012). Children's reading of printed text and hypertext with navigation overviews: The role of comprehension, sustained attention, and visuo-spatial abilities. *Journal of Educational Computing Research, 47*(1), 33–50. https://doi.org/10.2190/EC.47.1.b
Scharinger, C., Kammerer, Y., & Gerjets, P. (2015). Pupil dilation and EEG alpha frequency band power reveal load on executive functions for link-selection processes during text reading. *PLoS ONE, 10*(6), 1–24. https://doi.org/10.1371/journal.pone.0130608
Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004). Zoning out while reading: Evidence for dissociations between experience and metaconsciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 203–226). MIT Press.
Schöll, P. (2015). In P. Schöll (Ed.), *Berechnung des Lesbarkeitsindex Flesch nach Rudolf Flesch*. Available online at: http://fleschindex.de/ . (Accessed 1 January 2022).
Schurer, T., Opitz, B., & Schubert, T. (2020). Working memory capacity but not prior knowledge impact on readers' attention and text comprehension. *Frontiers Collection*. https://doi.org/10.3389/feduc.2020.00026
Schurer, T., Opitz, B., & Schubert, T. (2022). Concurrent prospective memory task increases mind wandering during online reading for difficult but not easy texts. *Memory & Cognition*. https://doi.org/10.3758/s13421-022-01295-1
Shapiro, A., & Niederhauser, D. (2004). Learning from hypertext: Research issues and findings. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 605–620). Lawrence Erlbaum Associates Publishers.
Smallwood, J. (2011). Mind-wandering while reading: Attentional decoupling, mindless reading and the Cascade model of inattention. *Language and Linguistics Compass, 5*, 63–77. https://doi.org/10.1111/j.1749-818X.2010.00263.x
Smallwood, J., McSpadden, M., & Schooler, J. W. (2008). When attention matters: The curious incident of the wandering mind. *Memory & Cognition, 36*, 1144–1150. https://doi.org/10.3758/MC.36.6.1144
Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin, 132*(6), 946–958. https://doi.org/10.1037/0033-2909
Smilek, D., Carriere, J. S. A., & Cheyne, J. A. (2010). Out of mind, out of sight: Eye blinking as indicator and embodiment of mind wandering. *Psychological Science, 21*, 786–789. https://doi.org/10.1177/0956797610368063
Soemer, A., & Schiefele, U. (2019). Text difficulty, topic interest, and mind wandering during reading. *Learning and Instruction, 61*(1), 12–22. https://doi.org/10.1016/j.learninstruc.2018.12.006
Sörqvist, P., Nöstl, A., & Halin, N. (2012). Working memory capacity modulates habituation rate: Evidence from a cross-modal auditory distraction paradigm. *Psychonomic Bulletin & Review, 19*(2), 245–250. https://doi.org/10.3758/s13423-011-0203-9
Stawarczyk, D., Majerus, S., Catale, C., & D'Argembeau, A. (2014). Relationships between mind-wandering and attentional control abilities in young adults and adolescents. *Acta Psychologica, 148*, 25–36. https://doi.org/10.1016/j.actpsy.2014.01.007
Stawarczyk, D., Majerus, S., Maj, M., Van der Linden, M., & D'Argembeau, A. (2011). Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method. *Acta Psychologica, 136*(3), 370–381. https://doi.org/10.1016/j.actpsy.2011.01.002
Storrer, A. (1999). Kohärenz in text und hypertext. In H. Lobin (Ed.), *Text im digitalen Medium. Linguistische Aspekte von Textdesign, Texttechnologie und Hypertext Engineering* (pp. 33–66). Westdeutscher.
Storrer, A. (2020). Textqualität digital: Ein modell zur Qualitätsbewertung digitaler texte. *Deutsche Sprache, 48*(2), 101–125. https://doi.org/10.37307/j.1868-775X.2020.02.03
Unsworth, N., & McMillan, B. D. (2013). Mind wandering and reading comprehension: Examining the roles of working memory capacity, interest, motivation, and topic experience. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 39*(3), 832–842. https://doi.org/10.1037/a0029669
Vargha, A., Rudas, T., Delaney, H. D., & Maxwell, S. E. (1996). Dichotomization, partial correlation, and conditional independence. *Journal of Educational and Behavioral Statistics, 21*(3), 264–282. https://doi.org/10.3102/10769986021003264
Waniek, J. (2002). *Globale Kohärenz in Hypertexten: Experimentelle Untersuchungen zum Generieren von kausalen und zeitlichen Inferenzen*. Retrieved from. University of Chemnitz http://archiv.tu-chemnitz.de/pub/2002/0090/data/Waniek.pdf. (Accessed 6 March 2021).