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Reading from paper, computers, and tablets in the first grade: The role of comprehension monitoring

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ABSTRACT

Recent meta-analyses indicate poorer comprehension when reading from computers or handheld devices compared to paper-based reading of informational texts. Meta-analyses also suggest that this screen inferiority effect may be linked to individual differences in metacognition. However, most paper vs. screen research to date has been conducted with university students. This study investigated whether the inferiority of screen-based reading from computers and handheld devices for informational texts is evident in beginner readers and related to comprehension monitoring skills. In a within-subjects design, first graders' (N = 58; M_{age} = 6.8 years) comprehension of main point, literal and inferential information was assessed using one narrative and one informational (i.e., descriptive) text read on paper, computer (laptop), and tablet. Comprehension monitoring was assessed through an inconsistency detection task. A standardized measure of reading comprehension was included as a control in the main analyses. Supplementary analyses controlling for word reading accuracy and medium preferences were also run. Linear mixed models showed superiority of main point comprehension for descriptive texts presented on tablets and inferential comprehension for narrative over descriptive texts, independent of medium. Results for literal comprehension were mixed. In addition, comprehension monitoring was related to main point and literal comprehension regardless of medium and had a greater effect on descriptive than narrative text comprehension at the inferential level. A screen inferiority effect was not detected in beginner readers' comprehension of texts from two digital mediums. Text comprehension was supported by metacognition, independent of medium.

1. Introduction

1.1. General context

In recent decades, there has been an unprecedented transformation in how people read; reading is not limited to printed texts but extends to texts displayed on digital devices such as computers and tablets [36]. In addition, an increase in the use of digital technologies has been reported for young children and school contexts (e.g., [22,45,57]). Due to these transformations, researchers have devoted increasing attention to the quality of reading comprehension when using digital technology [10,13,18,43,49,59].

Whilst much research has reported a screen inferiority effect for text comprehension in university students [10,18,30], recent studies of young readers do not find a consistent disadvantage for screen reading compared to print. For example, primary school children do not show poorer comprehension of main idea and literal information in texts presented on computers compared to print [3] and show only a small disadvantage for comprehension of texts presented on handheld devices (e.g., [49]). Similarly, studies that have involved young children with poor reading and cognitive skills, do not find a consistent effect of a screen disadvantage for text comprehension ([61] vs [48]). There is a critical need for more research to determine the robustness of any screen inferiority effect in young readers and to elucidate underlying textual

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and individual characteristics that influence the presence of this effect. This knowledge is pivotal for clarifying how textual characteristics and individual differences may hinder or promote comprehension and learning from digital texts. This knowledge is necessary to inform better designed digital reading assessments and educational tools.

1.2. Study objectives

To address this critical gap in knowledge, the first objective of this study is to investigate beginner readers' comprehension of linear and static texts by considering two text characteristics: medium (paper, computer, or tablet) and text genre (narrative and informative, specifically descriptive). The second objective is to investigate the role of comprehension monitoring as a potentially influential reader characteristic. Comprehension monitoring is a central component of metacognition, proven to have a crucial role in accounting for medium effects in older students' text comprehension (e.g., [47]). In pursuing both objectives, the ability to construct meaning from a text was investigated at more superficial and deeper levels of comprehension (main point, literal, and inferential level of comprehension).

The next paragraphs review the main literature on medium effects on text comprehension, focusing on the influence of textual characteristics (text genre and type of digital device) and individual characteristics (comprehension monitoring) on primary school children's reading comprehension.

1.3. Literature review

1.3.1. The role of text genre and type of digital device as text characteristics

The screen inferiority effect has been established in meta-analyses of university students and, in most cases, this effect is moderated by text genre [10,18,49,52]. The screen inferiority effect is found when reading informational texts under limited time conditions, for both superficial and deeper levels of text comprehension [10,18], but is not evident when reading narrative texts [52]. Of note, some of the previous meta-analyses have considered the type of digital reading device, that is, a computer or a handheld device. A previous meta-analysis found that the type of digital medium did not moderate the screen inferiority effect [18]. However, a more recent meta-analysis found a screen inferiority effect for handheld devices which was much smaller than the one found for computers in previous investigations [49].

Different hypotheses have been proposed to explain the screen inferiority effect (for a review, see [10]), but the shallowing hypothesis [2] is the more influential account. According to this hypothesis, readers process what they read more superficially when reading on screen than on paper because of their experience of short, quick, and shallow processing interactions when using digital media for purposes other than learning (i.e., for leisure). As a result, students experience difficulties with engagement for demanding reading tasks performed on a digital device. A tendency for more shallow processing when reading on a digital device is proposed to explain why a screen inferiority effect is found more commonly for informational than narrative texts; informational texts are longer and use more specialized vocabulary, complex syntax, and rhetorical structures than narrative texts [11].

Previous research with children found a consistent screen inferiority effect for students at the end of primary education (e.g., [17,25,41,50]). In contrast, recent investigations of younger readers did not find a disadvantage for reading on screen vs print (e.g., [3,48,53,61]). Different explanations have been proposed to account for the different pattern of findings across age groups. First, text comprehension tasks for young children could be less demanding in terms of the depth of comprehension required compared with those given to older students and adults. Second, lower primary school students may not have yet linked reading on paper with education and learning activities and reading on digital tools with leisure, which may reduce processing differences across media (e.g., [48]). Finally, research on young children's comprehension across different types of question (main point, literal, and inferential) suggests that an advantage of reading on screen is evident at a superficial level rather than a deeper level of comprehension [3].

Few studies on lower primary school children have explored the role of text genre. A notable exception is the comparison between fictional and non-fictional books in 4- to 5-year-olds by Furenes et al. [22]. The authors did not find an effect of medium but note that their participants were not independent readers (i.e., participants listened to a second person or application reading the text aloud). Computers are the digital medium used in most studies of primary school students, and, to our knowledge, none of the studies on younger readers have compared text comprehension on different digital media. The lack of such a comparison represents a critical gap in knowledge about the type of digital device and the screen inferiority effect in young readers for two main reasons. First, evidence suggests that reading from handheld devices may be less detrimental than reading from computers in primary school [41] and is not detrimental in preschoolers [16]. A possible explanation is that the physical experience of reading on paper and handheld devices is more similar regarding posture and holding the text than the physical experience of reading on a computer. Second, tablets are also the most popular and preferred digital device in 8- to 12-year-olds and children younger than eight years for both the screen size and ease of use [8,46].

1.3.2. The role of the reader's metacognitive characteristics

Metacognitive characteristics of the reader refer to reflective and regulatory skills or processes that contribute to effective learning and improved academic performance [54]. Metacognitive processes include planning (i.e., the definition of the goals of the learning task and the standards against which to monitor and evaluate performance), monitoring (i.e., the active control of comprehension and task performance), and evaluation (i.e., the assessments of learning processes and outcomes) of cognition during a learning task [7,38]. Investigations regarding the effect of medium on text comprehension in upper primary school students or older students have usually used a calibration measurement. That is, a metacognitive measure of the relation between a reader's self-evaluation of performance and actual performance in a text comprehension task [10,17,25,47]. In contrast, research on printed text comprehension in younger readers has mainly considered children's ability to detect textual inconsistencies as a measure of their ability to monitor their text comprehension (e.g., [33]).

Comprehension monitoring is typically assessed with error detection tasks that require children to identify text inconsistencies. According to developmental models of text comprehension, comprehension monitoring is a higher-level component skill (e.g., [28,40]). This higher-level skill uniquely contributes to processing and integrating linguistic information from the text with the reader's prior knowledge, over and above more fundamental skills (e.g., word reading, vocabulary) during the primary school years [33].

Meta-analytic studies find that both text comprehension (actual performance) and calibration are higher when reading from paper than screen in students who have mastered fundamental reading skills, mainly undergraduates [10]. Therefore, it has been proposed that readers process a text more superficially on screen than on paper because of poor calibration or metacognitive awareness of performance on a digital medium. Superficial processing, in turn, accounts for the screen inferiority effect in text comprehension. Studies included in Clinton's [10] meta-analysis considered a variety of digital devices. However, undergraduates reading from tablets did not demonstrate differences in metacognitive processes when reading from print and digital [12,34]. Potential factors proposed to explain this result in undergraduate students are the readers' medium preferences [12] and their motivation [34].

Research with secondary and upper primary school students that have used a calibration measurement find that participants' self evaluation and actual performance were better calibrated when reading

narrative and informational texts on paper than on screen [17,25]. Calibration differences mediated medium effects on comprehension of the main idea and key points in informational texts [47]. In grades 2-5, students demonstrated metacognitive processes (planning, monitoring, and evaluation) in both paper and digital reading conditions, but were more likely to apply metacognitive skills when reading various text genres on paper than on a computer screen [54]. Although positive metacognitive effects of the digital medium have been documented in third- to fifth-graders reading e-books on tablets [14], all but one of the previous studies [47] compared texts presented on computers and paper. Therefore, they did not include handheld devices. In addition, they did not examine potential text genre effects on the relation between metacognitive processes and text comprehension.

1.4. The present study

To address gaps in previous knowledge, this study examined the effects of reading on paper and different digital media (computer and tablet) and reading text genre (narrative and descriptive), and their relations to metacognition (i.e., comprehension monitoring skills) in independent readers. Critically, our participants were younger readers than those involved in most previous research, providing much needed information on the factors that influence reading comprehension in beginner readers. Text comprehension was investigated at different levels identified in theoretical models that explain how readers can construct the meaning of text more superficially or deeply (e.g., [29]). Following previous investigations [55,56], we assessed comprehension of the main point of each text as the overarching topic or theme and explicit information through literal questions. The more demanding skill of inferencing was measured through inferential questions whose answers were not within the texts.

Two main specific research questions (RQ) guided our work: (RQ1) Do either reading medium (paper vs computer vs tablet) and/or text genre (narrative vs. descriptive) differentiate text comprehension in children at the end of the first year of primary school? (RQ2a) Does children's metacognition assessed through their comprehension monitoring skills relate to comprehension of different text genres presented on different media at the end of the first year of primary school? (RQ2b) If reading medium and text genre differences are observed for text comprehension, are they associated with children's metacognition assessed as comprehension monitoring skills? In addressing both RQs, the individual's reading comprehension level was also controlled. According to the comprehension-level hypothesis [50], higher text comprehension skills are linked to higher-order skills such as inferencing, comprehension monitoring, and background knowledge, which could moderate the screen inferiority effect. Indeed, primary school students with low reading comprehension skills comprehended better when reading under time pressure in print than on tablet. On the contrary, text comprehension of primary school students with high reading comprehension skills was not affected by medium [50]. The potential intervening roles of word reading accuracy and reading medium preferences [12,27] were controlled in supplementary, exploratory, analyses. Variability in fundamental reading skills and reading from a preferred or not preferred medium affect the extent to which students allocate cognitive resources to higher-level comprehension processes, such as metacognition, and, therefore, may also moderate the screen inferiority effect.

Overall, we did not predict a screen inferiority effect on text comprehension in beginner readers (RQ1). However, given the mixed results from the literature, the medium effect might vary according to different factors: text genre, type of digital medium, and level of text comprehension (e.g., [22,41,49]). Concerning the moderating role of text genre, we might expect no effect of text genre because informational texts used in the present study provided information embedded in a narrative structure [22]. Concerning the type of digital medium and level of text comprehension, we might expect better text comprehension performance when children read on tablets than computers and at more superficial levels of text comprehension [3,41,49].

For RQ2a, we expected comprehension monitoring to be associated with text comprehension on paper and digital media [54]. We also expected the relationship between comprehension monitoring and text comprehension to be moderated by the type of digital medium [12,14,25], while no clear prediction can be made on the effect of text genre (RQ2b).

2. Method

2.1. Participants

In a within-subjects design, we assessed 58 first graders (mean age = 6.8 years; 47 % females) who participated with verbal assent and their parent's written consent. Information about children and parents is presented in Table 1.

Initially, a convenience sample of 62 participants was recruited, but the data of four were excluded because children had been referred to the National Health Services for cognitive impairments or language difficulties (teacher report). Participants in this study were all born in Italy and included in a larger project on medium effects on text comprehension in beginner readers. This paper's hypotheses, measures, analyses, and results are unique to this study. The Institutional Ethics Committee approved the study. The children attended three classes in one primary public school that served a population with a middle-class social background.

Parents (N = 43) completed questionnaires on demographic information and children's use of digital devices in the home environment (details in Table 1). Seventy-eight percent of parents had a high school (59 %) or secondary school degree (19 %), in line with the homogeneous middle/working-class social background of the school area. According to parental reports, most children had access to handled devices, in particular tablets, followed by game consoles, a minority used laptops/computers, and none used e-books. Parents reported that 44 % to 58 % of the children used smartphones, tablets, and game systems for between less than once a week to more than once a week, while 31 % used laptops and 2 % used computers with the same frequency. Finally, few children had access to digital devices daily and the percentage of children who never used digital devices ranges from 35 % (for tablet) to 91 % (for computer). According to teacher reports, the children used technology for educational activities 2-4 hours per month. In Italy, the national curriculum for teaching digital skills in public primary schools requires children to spend one hour per week using computers.

2.2. Materials

2.2.1. Reading materials

Six texts about animals were used, two narrative and two descriptive (informational). The six texts were materials devised specifically for a wider project on text comprehension on paper, computer, and tablet ([3,4]; osf.io/sf9j4). All narrative and descriptive texts were devised to represent the text genres used in the first grade and, therefore, appropriate to identify possible differences across media [18,42]. The narrative texts introduced a short story about an animal (a teddy bear, hedgehog, and dolphin). The descriptive texts provided information about an animal's physical characteristics and behavior (a tortoise, parrot, and pig). The length (101-106 words), structure, and linguistic construction of the texts were carefully devised based on textbooks suggested by language arts teachers and independently evaluated by education and language development experts. Readability and lexical proprieties and examples of the texts are reported in Appendix A and Appendix B, respectively.

2.2.2. Text comprehension measure

Text comprehension was measured at three levels [56] using

Table 1
Children's and parents' characteristics

			%	M (SD), Range
Children				
Gender (female vs. male)			47	
Age (years/months)				6.8 (3.5), 6.4-7.4
Parents[a]				
Educational level (average level of mothers and fathers)				
	Secondary school degree		19	
	High school degree		59	
	College degree[b]		20	
	PhD/MD		2	
Children using digital devices				
	Smartphone		58	
	Tablet		65	
	Computer		9	
	Laptop		33	
	E-book		0	
	Game consoles		46	
Children's frequency of use of digital devices[c]				
	Smartphone	Never	41	
		Between less than once a week to more than once a week	44	
		Once a day or more than once a day	14	
	Tablet	Never	35	
		Between less the once a week to more than once a week	58	
		Once a day or more than once a day	7	
	Computer	Never	91	
		Between less than once a week to more than once a week	2	
		Once a day or more than once a day	7	
	Laptop	Never	67	
		Between less than once a week to more than once a week	31	
		Once a day or more than once a day	2	
	Game consoles	Never	54	
		Between less than once a week to more than once a week	46	
		Once a day or more than once a day	0	

[a] Note. N = 43.
[b] Bachelor degree/Masters degree.
[c] None of the children used E-books, therefore the frequency of use of E-books is not reported.

multiple-choice questions with four alternative answers: main point (one question about the main theme), literal comprehension (three questions), and inferential comprehension (three questions) for each text (see Appendix B for some examples and osf.io/sf9j4 for the complete set of questions). The first author devised multiple-choice questions that were independently evaluated by the last author and an expert in language development. Some had been used in a previous study [4]. Written verbal questions were used to ensure a comparable presentation of questions across media and because they were commonly used in text comprehension assessments at school (Language Arts Teachers report). Each correct answer was awarded 1 point (the maximum score for each text was 7: 1 point for main point, 3 points for literal questions, and 3 points for inferential questions). Three scales were computed as the sum of the corresponding items: the main point, literal comprehension, and inferential comprehension. As in a previous study [3], a confirmatory factor analysis (CFA) acknowledged the three-factor structure of the dependent variable (see Figure S1 of the supplementary materials for the resulting model and FIT indexes).

2.2.3. Comprehension monitoring task

An inconsistency detection task of twelve stories (Language and Reading Research Consortium & [33]) was adapted for Italian pupils by the first and last author. There were eight stories with two inconsistent sentences and four without inconsistencies, which were used as fillers (osf.io/sf9j4). Stories were three to six sentences long, and inconsistent/consistent information appeared in adjacent or distant sentences. Children were told that the stories might contain inconsistent information and were asked to listen to the stories (which were also made available to children in written form) and identify the inconsistent sentences. There were three practice trials with feedback. The detection of both inconsistencies in each of the eight inconsistent stories was awarded one point. The total maximum score was 8. McDonald's omega for the present sample was .77.

2.2.4. Reading comprehension test (control variable)

The Italian standardized test *Prove MT-3-Clinica* [15] was used. Each participant read a grade-appropriate text with ten corresponding multiple-choice questions. There was no time limit and children were allowed to return to the text while answering questions. Comprehension questions had four alternatives with only one correct answer. The raw score was the sum of correct answers (maximum score of 10). McDonald's omega for the current sample was .70.

2.2.5. Medium preference questions (control variable)

Before reading the texts, participants completed a preference question asking whether they preferred reading a text on paper (score 0), computer (score 1), or tablet (score 2). Medium preference question (scoring range: 0-2) at the pre-test was considered in the supplementary analysis.

2.2.6. Word reading accuracy test (control variable)

The Test Battery for the Evaluation of Developmental Dyslexia and Dysorthography [51] was used. Children were asked to read 112 words and 48 non-words without errors and as fast as possible. The words and non-words were bi-, tri-, and quadrisyllabic items (the total number of syllables was 281 for the word reading task and 127 for the non-word reading task) and differed in frequency and concreteness (ranging from high to moderately low). Reading accuracy (number of correct answers/number of items) was computed for both tasks. The reliability (McDonald's omega) for accuracy for words and non-words in the present sample was .75.

A composite score of word reading accuracy was computed by averaging Z scores and used in the supplementary analysis.

2.3. Procedure

The measures were administered in five sessions (see Fig. 1 for a graphic outline of the methodological process), approximately one week apart, at the end of the school year (during May and June) as part of the broader project. Each session was 30-40 minutes long. Except for the standardized reading comprehension test that was group-administered, measures were administered individually in a quiet room of the school and in a counterbalanced order.

In session A, students were given the standardized reading

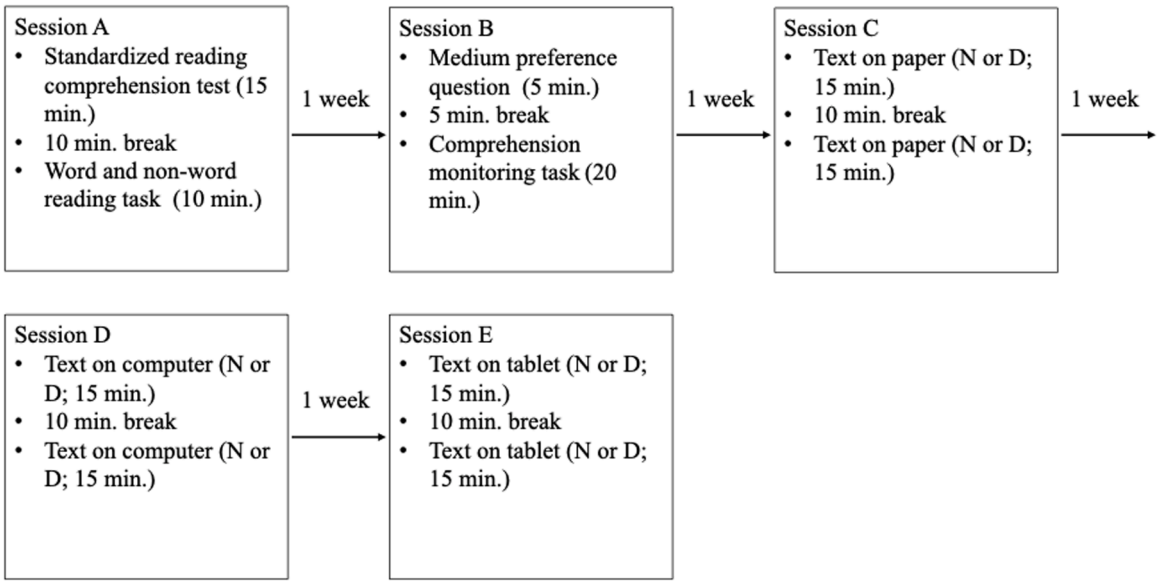

Fig. 1. Graphic outline of the methodological process, note. N = Narrative; D = Descriptive.

comprehension test and the word and non-word reading task. In session B, children answered the medium preference question at the pre-test and completed the comprehension monitoring task. In sessions C, D, and E, each student read six texts, two on paper, two on a computer (laptop), and two on a tablet (one narrative and one descriptive in each medium), and responded to six sets of comprehension questions. The order of text presentation was randomized by medium and genre. Each text was presented on a single page followed by the comprehension questions (two on the first page, three on the second, and two on the final page; examples in Figure S2 of the supplementary materials). Comprehension questions were asked and answered in the same medium used to present the text; the children had to tick, click, and tap the correct answer when reading on paper, computer, and tablet, respectively. All children used the mouse and navigated autonomously to perform the text comprehension tasks on the digital media. Children could access texts while answering questions in all media. They read the texts at their own pace since the task had no time limit. The font size of all texts and questions was 16-point Cambria, the same as in textbooks, with capital letters as in daily teaching activity. Double-spaced A4 sheets were used to present the printed texts (see Figure S2). Digital texts appeared on a 17″ laptop computer screen (1280 × 1024 pixels) and on a 9,7 iPad (2048 × 1536) using the open-source software LimeSurvey (see Figure S2). In the paper and digital conditions and both for texts and questions, the color of the sheet was white and the color of text was black. No other colors were used, except for a blue icon to turn pages that was placed at the bottom-right of each page in the digital conditions. In conclusion, the digital versions of texts and questions presentation matched those on the paper-based version as closely as possible, with minor modifications to reflect the digital rather than paper-based environment [20].

2.4. Data analysis

First, a post hoc power analysis with a sample of 58 participants was run using simulation (number of simulations = 1000; [31]) to estimate the statistical power of detecting the effects of our main expectations with a fully within mixed model. Second, descriptive statistics were computed for all the variables of the study. Third, linear mixed models were used to address RQ1 and RQ2 by testing the potential role of medium (i.e., paper, computer, tablet), text genre (i.e., narrative text; descriptive text), and comprehension monitoring, controlling for the potential confounding effect of reading comprehension. The dependent variables were the sum of correct answers to the main point, literal, and inferential questions. The use of these composite scores was preferred to the use of the dichotomous answer (0 = incorrect; 1 = correct) to each comprehension question considered separately to favor clarity of interpretation of results. The use of composite scores for the main point, literal, and inferential questions was supported by the test of the factorial structure for the text comprehension measure (see section 2.2). For each dependent variable (main point, literal, and inferential questions), two models were computed. A first model (Model 1) with all the main effects and the interaction between text genre and medium (RQ1 and RQ2a). A second model (Model 2) also including the two-way and the three-way interactions between text genre, medium, and comprehension monitoring (centered; RQ2b). Observations (i.e., correct answers to the main point, literal and inferential comprehension, as measured repeatedly in each participant for each medium and text genre) are nested in students.

Estimation problems prevented the fit of planned models with both random intercepts and slopes. As Barr et al. [5] recommend, non-converging models were dealt with by progressively simplifying the random effects structure until convergence was reached. This resulted in a random-intercept-only model. When the text genre by medium interaction was found significant, we explored the differences between media in each text genre with Tukey's HSD test corrected for multiple comparisons to control for Type I error rate. When the interactions with comprehension monitoring were found significant, a simple slope analysis was performed to explore the direction of the effect, and data were plotted. As supplementary control analyses, we repeated the linear mixed models (for brevity only Model 2; see Supplementary Materials) using logistic mixed models on dichotomous answers to each comprehension question separately and controlling for the following potential confounders: reading preference before reading the six tests and word reading accuracy.

Analyses were performed with R [44] using the lme4 package [6] to test linear and generalized mixed models and the lmerTest [32] to obtain standard errors for linear mixed models. The percentage of variance explained by each model was computed following Nakagawa et al. [39], including both marginal R^2 and conditional R^2, which refer to the variance explained by the fixed effects and the global variance of random and fixed effects, respectively. Plots were built with the ggplot2 package [60].

3. Results

3.1. Post-hoc power analysis and descriptive analysis

The post-hoc power analysis showed an achieved power of more than 80 % to find a significant difference between tablet and paper conditions, and more than 90 % to detect the significant interaction between medium and text genre for inferential questions. This result showed that the sample size in the present study did not play a role in limiting the detection of significant differences for the crucial multiple comparisons (see section 3.2.1) and interaction (see section 3.2.2).

The descriptive statistics for correct answers on text comprehension measures in the paper, computer and tablet conditions are shown in Fig. 2.

Fig. 2 reports the average performance (with standard error bars) for the dependent variables - main point, literal and inferential questions - in the three media, for narrative and descriptive texts. Fig. 2 also represents the results of the significant multiple comparisons across media (discussed in section 3.2.1). The average performance (with *SD*, range, skewness and kurtosis) for the comprehension monitoring task and the control variables are presented in Table 2.

Children's average score in the comprehension monitoring task was 4.78 (total possible score of 8). According to available norms for children in the first year of schooling [15], 95 % of participants had average or good reading comprehension levels. All others performed at below-average levels but were not removed from the analyses because none had cognitive impairments or were at risk for learning difficulties. Performances on the comprehension monitoring task and reading comprehension test covered almost the whole range of possible scores, and these tasks did not suffer from either floor or ceiling effects. Data for the comprehension monitoring task and all control variables did not deviate substantially from normality for skewness and kurtosis, which were within the acceptable range [58].

Table 2
Descriptive statistics for comprehension monitoring, reading comprehension, and control variables considered in supplementary analyses.

	Mean	SD	min	max	Skewness	Kurtosis
Comprehension monitoring	4.78	2.97	0	8	-0.45	-0.93
Reading Comprehension	7.17	1.48	2	10	-0.20	-0.34
Reading preference Pre-Test	0.98	1.48	0	2	0.03	-1.63
Reading accuracy[a]	0.00	0.73	-3.02	1.41	-0.98	1.33

[a] Note. Composite Z score.

3.2. Effects of medium and text genre (RQ1) and comprehension monitoring (RQ2) on the main point, literal and inferential comprehension

The results of the linear mixed models (both fixed and random effects) for the main point, literal, and inferential questions are reported in Tables 3, 4, and 5, respectively.

In each table, Model 1 shows the main effects of medium, text genre, and comprehension monitoring and the interaction between medium and text genre (RQ1 and RQ2a), and Model 2 shows the interactions

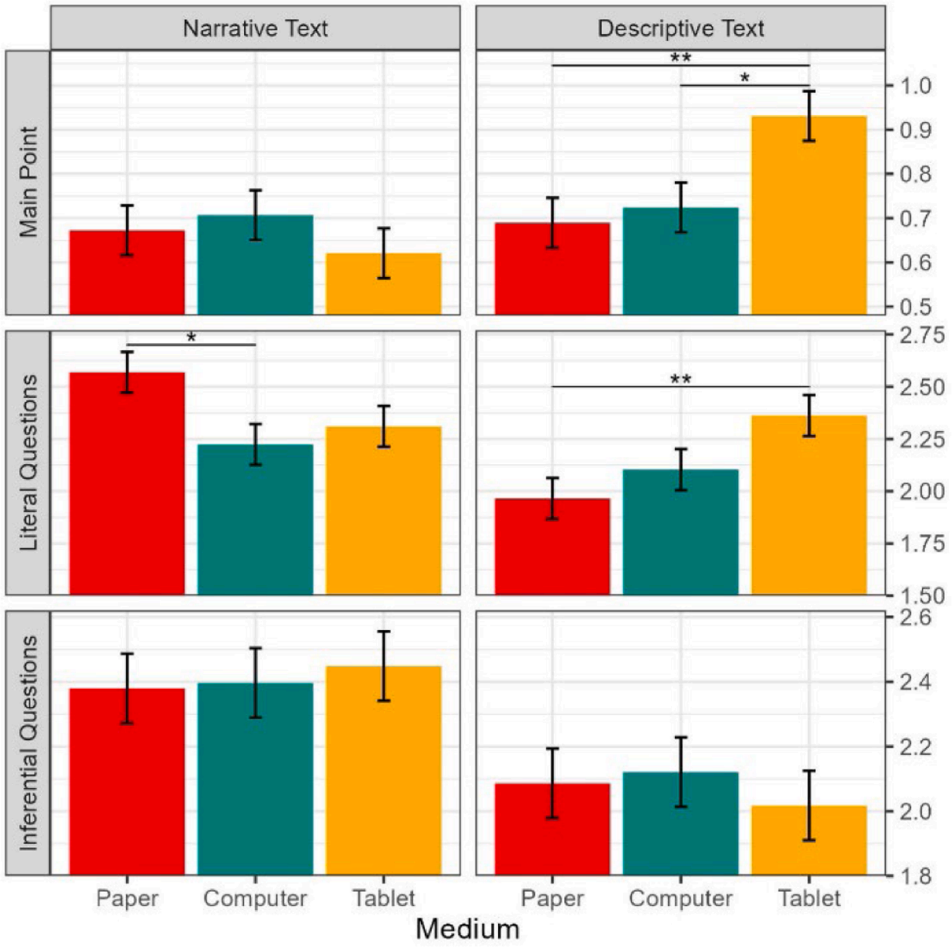

Fig. 2. Correct answers (average performance with standard error bars) for the main point, literal and inferential questions in the paper and digital and narrative and descriptive texts, and significant multiple comparisons across media, Note. * $p < 0.05$; ** $p < 0.01$.

Table 3
Effect of medium, text genre, and comprehension monitoring as the independent variables, and their interactions on the main point questions as the dependent variable (Controlling for Reading Comprehension).

	Model 1						Model 2					
	Num DF	Den DF	*F*	*p*	η^2	90 % CI[a]	Num DF	Den DF	F	P	η^2	90 % CI[a]
Fixed effects												
Reading comprehension	1	340	11.30	<0.001	0.03	0.01-0.07	1	335	11.26	<0.001	0.03	0.01-0.07
Medium	2	340	1.47	0.23	0.01	0.00-0.03	2	335	1.47	0.23	0.01	0.00-0.03
Text genre	2	340	6.32	0.01	0.02	0.01-0.05	1	335	6.30	0.01	0.02	0.00-0.05
Comprehension monitoring	1	340	8.79	0.003	0.02	0.01-0.06	1	335	8.76	0.003	0.02	0.01-0.06
Medium*Text genre	2	340	4.57	0.01	0.02	0.00-0.06	2	335	4.55	0.01	0.02	0.00-0.06
Medium*Comprehension monitoring							2	335	0.05	.95	0.00	0.00
Text genre*Comprehension monitoring							1	335	2.71	0.10	0.01	0.00-0.03
Medium* Text genre*Comprehension monitoring							2	335	0.57	.57	0.00	0.00-0.02
Random Effects												
σ2	0.18						0.18					
τ00 ID	0.00						0.00					
Marginal R^2 / Conditional R^2	0.11 / 0.11						.12 / 0.12					

[a] Note. 90 % Confidence Interval for η^2; σ2 = residual variance; τ00 ID = Between-group random intercept variance.

Table 4
Effect of medium, text genre, and comprehension monitoring as the independent variables, and their interactions on the literal questions as the dependent variable (Controlling for Reading Comprehension).

	Model 1						Model 2					
	Num DF	Den DF	*F*	*p*	η^2	90 % CI[a]	Num DF	Den DF	F	P	η^2	90 % CI[a]
Fixed effects												
Reading comprehension	1	55	14.86	<0.001	0.04	0.07-0.35	1	55	14.86	<0.001	0.04	0.07-0.35
Medium	2	285	1.91	0.15	0.01	0.00-0.04	2	280	1.89	0.15	0.01	0.00-0.04
Text genre	1	285	9.53	0.002	0.03	0.01-0.07	1	280	9.44	0.002	0.03	0.01-0.07
Comprehension monitoring	1	55	8.83	0.004	0.02	0.03-0.28	1	55	8.83	0.004	0.03	0.03-0.28
Medium*Text genre	2	285	7.29	<0.001	0.04	0.01-0.09	2	280	7.22	<0.001	0.04	0.01-0.09
Medium*Comprehension monitoring							2	280	0.41	0.66	0.00	0.00-0.02
Text genre*Comprehension monitoring							1	280	0.88	0.35	0.00	0.00-0.02
Medium* Text genre*Comprehension monitoring							2	280	0.28	0.75	0.00	0.00-0.01
Random Effects												
σ2	0.46						0.46					
τ00 ID	0.09						0.09					
Marginal R^2 / Conditional R^2	0.18 / 0.32						0.18 / 0.32					

[a] Note. 90 % Confidence Interval for η^2; σ2 = residual variance; t00 ID = Between-group random intercept variance.

between medium, text genre, and comprehension monitoring (RQ2b). Model 1 and Model 2 also report the effect sizes for each main effect and interaction with their 90 % Confidence Intervals (CI).

3.2.1. RQ1 text comprehension

Results of Model 1 in Tables 3, 4, and 5 showed significant main effects of text genre on the main point, literal, and inferential comprehension questions ($ps \leq 0.01$; η^2 ranging from 0.02 to 0.05). Medium did not have a significant main effect on any of the three dependent variables ($ps > 0.15$). Reading comprehension, as a control variable, had significant main effects on all levels of comprehension: main point, literal, and inferential comprehension questions ($ps < 0.001$; η^2 ranging from 0.03 to 0.05).

The significant main effects of text genre on the main point and literal, but not inferential, comprehension questions were qualified by significant interactions between text genre and medium ($ps \leq 0.01$; $\eta^2 = 0.02$ for main point questions, $\eta^2 = 0.04$ for literal questions; $p = 0.69$ for inferential questions). Significant multiple comparisons are presented in Fig. 2 (see Table S1 and Table S2 in the Supplementary Materials for all multiple comparisons and effect sizes for main point and literal questions, respectively). These show that correct answers on the main point questions were higher for descriptive texts read on a tablet than on paper

Table 5
Effect of medium, text genre, and comprehension monitoring as the independent variables, and their interactions on the inferential questions as the dependent variable (Controlling for Reading Comprehension).

	Model 1						Model 2					
	Num DF	Den DF	*F*	*p*	η^2	90 % CI[a]	Num DF	Den DF	F	P	η^2	90 % CI[a]
Fixed effects												
Reading comprehension	1	55	17.21	<0.001	0.05	0.09-0.38	1	55	17.21	<0.001	0.05	0.09-0.38
Medium	2	285	0.05	0.96	0.00	0.00-0.00	2	280	0.05	0.96	0.00	0.00-0.00
Text genre	1	285	17.06	<0.001	0.05	0.02-0.11	1	280	17.27	<0.001	0.05	0.02-0.11
Comprehension monitoring	1	55	4.82	0.03	0.01	0.00-0.21	1	55	4.82	0.03	0.01	0.00-0.21
Medium*Text genre	2	285	0.37	0.69	0.00	0.00-0.02	2	280	0.37	0.69	0.00	0.00-0.02
Medium*Comprehension monitoring							2	280	0.73	0.48	0.00	0.00-0.02
Text genre*Comprehension monitoring							1	280	4.13	0.04	0.01	0.00-0.05
Medium* Text genre*Comprehension monitoring							2	280	1.52	0.22	0.01	0.00-0.03
Random Effects												
σ2	0.57						0.56					
τ00 ID	0.10						0.10					
Marginal R^2 / Conditional R^2	0.15 / 0.27						0.16 / 0.29					

[a] Note. 90 % Confidence Interval for η^2; σ2 = residual variance; τ00 ID = Between-group random intercept variance.

(p = 0.01, d = -0.57) and computer (p = 0.03, d = -0.49), whilst no differences were detected for narrative texts (ps > 0.52). Considering performance on literal questions, correct answers were significantly higher when reading on paper than on computer for narrative texts (p = 0.02, d = 0.51); no other significant differences across media were detected for narrative texts (ps > 0.10). When participants read descriptive texts, correct answers on literal questions were significantly higher on tablets than on paper (p = 0.01, d = -0.59); no other significant differences across media were detected for descriptive texts (ps > 0.10).

3.2.2. *RQ2 comprehension monitoring*

Model 1 results reported in Tables 3, 4, and 5 showed the significant and unique main effect of comprehension monitoring on all levels of comprehension: main point, literal, and inferential comprehension questions (ps < 0.03; η^2 ranging from 0.01 to 0.02; RQ2a). Model 2 showed that the main effect of comprehension monitoring was not qualified by significant interactions for the main point and literal questions (ps > 0.10), but a significant comprehension monitoring by text genre interaction was found for inferential questions (p = 0.04; η^2 = 0.01; RQ2b). Fig. 3 shows the simple slope analysis to interpret this moderation effect.

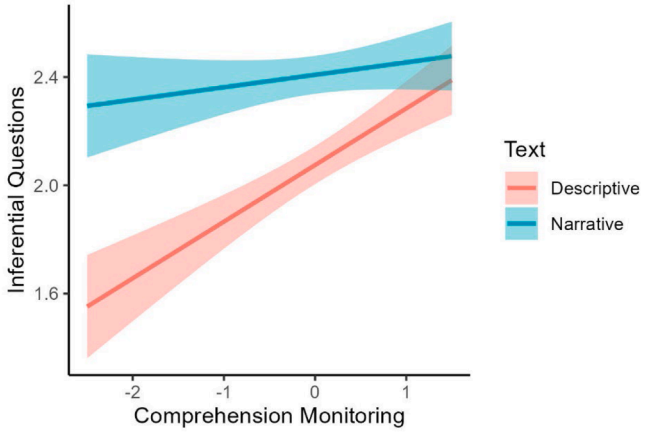

Fig. 3. Simple slope analysis of the interaction between text genre and comprehension monitoring (Z Scores) on inferential questions (Average Correct Answers).

Fig. 3 represents the average correct answers on the inferential questions depending on correct answers in the comprehension monitoring task (Z scores) for narrative texts (red line) and descriptive texts (blue line). Comprehension monitoring had a positive significant effect on inferential questions when the text genre was descriptive (b = 0.21, SE = 0.07, t = 2.96, p = .004), but no significant effect when the genre was narrative (b = 0.04, SE = 0.07, t = 0.65, p = .516). These results showed that, although inferential comprehension was lower for descriptive than narrative texts overall, performance on inferential questions in these two text genres (descriptive and narrative) was similar for children with higher comprehension monitoring skills.

3.2.3. *Supplementary control analyses*

The results of the three parallel logistic mixed models are reported in Table S3 in the Supplementary Materials. These analyses largely confirm the results obtained with linear mixed models. An exception is the effect of the interaction between text genre and comprehension monitoring in predicting correct answers to the inferential questions that did not reach the significance level. Therefore, some caution is requested in the interpretation of the previous result. The linear mixed models controlling for the potential confounding effects of reading preference (responses collected before reading the six tests: see Table S4, Supplementary Materials) and word reading accuracy (see Table S5, Supplementary Materials) showed no substantial differences compared to the target analyses. Therefore, no potential confounding effect of reading preference and word reading skills was found.

4. Discussion

The present study sheds light on potential mechanisms of the medium effect on beginner readers' text comprehension. This provides important new information given concerns that studies to date present an inadequate and oversimplified understanding of the source of reported differences between paper versus digital reading [13]. This study adds to the existing literature (e.g., [48,49,61]) in two critical ways.

First, by analyzing comprehension of linear, static, and comparable texts presented on paper and two digital devices (computer and tablet) across two different genres (narrative and informational; RQ1). Second, by examining the medium and text genre effects on comprehension in relation to the reader's comprehension monitoring skills (RQ2). In the analyses, text comprehension was investigated both at more superficial and deeper levels. We discuss the main results of the study, its limitations, and practical educational implications.

4.1. Small digital reading advantage for informational text comprehension at the superficial level and on a familiar handheld device (RQ1)

The findings of the study partially confirm our main expectations for RQ1. Overall, beginner readers did not show a comprehension disadvantage when reading narrative and informational text from two digital devices. We found no evidence to support the shallowing hypothesis [2]. These findings are in line with previous evidence from studies on early and middle school students reading from computers [3,48]. Our findings are not in line with a recent meta-analysis involving primary school students reading from handheld devices [49], but that meta-analysis merged data from primary and secondary school students. Given that the superiority of reading comprehension on paper is a major outcome of comparative research on reading medium from the end of primary school onwards, grouping data from studies with mixed educational levels may explain the different results of the present study and the recent meta-analysis.

Despite the above-mentioned differences, the findings reported here, alongside previous research, suggest that the screen inferiority effect is small at early educational levels. Importantly, the present study further specifies what text and reader characteristics may moderate the effect of the medium and limit the applicability of the shallowing hypothesis for beginner readers.

Concerning text characteristics, the effect of the medium was moderated by text genre and type of medium at certain levels of text comprehension. For informational text comprehension, a small advantage of digital reading was detected at the superficial levels of comprehension (mainly for main point questions) but not at the deep level of inferential comprehension. In addition, this advantage was found when children read on a handheld device (i.e., a tablet) but not on a computer. Our participants were also more familiar with handheld devices (i.e., tablets) than computers, according to information from parents' questionnaires. These findings partly align with previous results on beginner readers that showed an advantage for main point and literal text comprehension when reading from a digital device (computer) widely used for school activities [3]. However, the advantage of digital reading comprehension in the current study is limited to descriptive texts, also defined as informational mixed texts or informative texts with a narrative structure [42]. Prior investigations reported that text genre does not moderate the effect of the medium in young children (e.g., [22]), which may be because informational texts used with younger students are less demanding in terms of complex vocabulary and structure compared to informational texts used with older students [11,23]. However, studies conducted with young readers have mainly used computers as digital devices. The results of the present study suggest that the type of digital device, which was a handheld device, may explain the advantage for superficial comprehension of informational text.

The findings of this study support the role of handheld devices for reading comprehension. Our findings do not align with early meta-analytic studies that reported no a moderating effect of type of device on reding comprehension [18]. However, in the Delgado et al.'s [18] meta-analytic research, the number of studies that used handheld devices was limited and the metanalysis did not focus on familiarity with handheld devices. Our results partly converge with evidence suggesting that handheld devices and familiarity with their use may be less detrimental to text comprehension in primary and secondary school (e.g., [9,12,41,49]). Multiple reasons may account for the advantages of reading on tablets. Mangen and Van der Weel [37] suggested that tablets, but not computers, are compatible with an embodied view of reading. According to this view, readers can establish a physical relation with the device, which may favor the application of reading strategies in their ongoing comprehension processes. Also, the easy interface of this medium [8,9], in conjunction with familiarity with the medium found in this study, may facilitate the acquisition of basic digital skills that are required to access and navigate linear texts in digital media but not on paper [41].

An in-depth discussion of the effect of the familiarity with digital devices on text comprehension requires consideration of children's use of such devices, as reported in this study and other work [8,45]. Of note, this other work found that children mainly use tablets to watch videos, listen to music, and play games. We conclude that children use tablets mainly for leisure activities, but this does not harm their reading comprehension, in contrast to the shallowing hypothesis [2]. A possible explanation for the absence of a detrimental effect of reading on tablets in younger readers, is that they have much less accumulated experience of using the digital medium for leisure versus reading on paper mainly for study and learning than much older students (e.g., [48]). In addition, according to parental reports of digital habits, the young participants in the present study used tablets approximately weekly. This usage frequency is likely lower than that of older students. Contrary to mature readers, it is also unlikely that beginner readers in this study were involved in digital activities defined as social-communicative reading (e.g., use of social networks and blogs; [1,50]) that may strongly contribute to creating a habit of superficial processing when reading on digital media. However, this interpretation is speculative as we did not collect information on the frequency of social-communicative practices.

Considering the effect of medium on narrative text genre, an advantage of digital reading was not detected for narrative texts at all three comprehension levels. Although results for literal questions were mixed, an advantage of narrative text comprehension on the paper medium compared to the computer medium was evident at the literal level. Better comprehension of narrative than descriptive text was apparent at the deeper inferential level of text comprehension, independently of the medium. Data on the use of technology at home and school reported in this study and existing evidence might shed light on findings for the literal and inferential level. Our participants did not use e-books at home and used laptops and computers to a limited extent at school. Those data suggest that activities such as shared book reading at home and instruction on text comprehension at school mainly involved the paper medium. In addition, since instruction on text comprehension in primary school usually considers narrative texts [26], it is likely that our participants were mainly exposed to narrative printed texts. The higher exposure to narrative texts on paper might clarify the advantage of narrative text comprehension on paper at the literal level. It can also shed light on the contradictory result of better narrative than descriptive text comprehension at the deeper inferential level. Since narrative texts are very familiar to children [22,26], relevant knowledge (e.g., background knowledge and knowledge of the narrative structure) for higher-order inference generation processes can be readily available for narrative texts regardless of the medium [11,24].

One final remark on text-related characteristics that may contribute to the screen inferiority effect (or absence thereof) concerns the presentation of the texts. Participants in the current study were tested individually or, in other words, in reading contexts that allow for concentration and engagement with the texts. It has been suggested that these contexts support the emergence of the superiority of print in terms of comprehension in university students; differences across media are not evident in more distracting group sessions involving younger readers [49]. The design of the present study did not allow comparison of individual and group sessions. Nevertheless, our findings suggest that an individual reading context may not potentiate the screen inferiority

effect at different comprehension levels in young readers. This evidence aligns with results reported for older students [34] and adds to previous studies that implemented group sessions in elementary school (e.g., [48]).

4.2. Comprehension monitoring relates to text comprehension across media and interacts with text genre on inferential questions (RQ2)

Our findings partially confirm expectations for RQ2a; comprehension monitoring, as a reader characteristic, was positively associated with text comprehension on paper and both digital media. This result contributes to the qualitative data collected by Sergi et al. [54]. It suggests that primary school students apply metacognitive skills, specifically comprehension monitoring, when reading on paper and two digital media in children younger than second graders. Our results provide a conceptual reproduction of previous research showing that comprehension monitoring explains individual differences in reading comprehension in beginner readers [33]. The present study extends previous work demonstrating that this finding generalizes across narrative and informational texts and two levels of comprehension (literal, main point). Specifically, comprehension monitoring contributes by a small, but unique, extent to comprehension of different text genres on various media over and above general measures of reading skills.

Contrary to expectations, the relation between comprehension monitoring and text comprehension was not moderated by the type of digital medium (RQ2b). No main effect of medium or interactions between medium and comprehension monitoring emerged in our study. Therefore, our results did not demonstrate differences in metacognitive processes when reading on digital media and at various levels of text comprehension. The linear and static texts with few distractions presented in the print and digital conditions of this study may contribute to explaining the few differences in metacognitive processes across media. Qualitative observations showed few differences in young children's reading behaviors (i.e., metacognitive behaviors) when reading linear static texts on paper vs on a computer [4]. This contrasts with studies of upper primary and lower secondary school students [17,25,47,54]. These studies, however, used more complex texts than those used in studies with first graders and different metacognitive measures (i.e., calibration assessed in both printed and digital media) than the comprehension monitoring measure adopted in the present work.

The current study did not allow us to analyze whether comprehension monitoring accounts for text comprehension differences across digital media since we did not detect a screen inferiority effect, particularly expected when reading on a computer. Instead, this study adds to the knowledge base concerning factors that might moderate the association between metacognitive processes and text comprehension in younger students. Contrary to the evidence reported for undergraduates [12], children's medium reading preferences at pre-test (see supplementary control analyses) did not act as a confounding factor of the contribution of comprehension monitoring to text comprehension in digital media.

Our results provide evidence that the contribution of comprehension monitoring may be moderated by text genre at the deep level of text comprehension (RQ2b). This finding should be interpreted with caution given the results of supplementary control analyses, which found a main effect, but not an interaction, of comprehension monitoring on inferential questions. However, the moderation effect of comprehension monitoring and text genre in main analyses suggests that comprehension monitoring skills may compensate for any lack of relevant knowledge (e.g., background knowledge and knowledge of text structure) for inference generation in descriptive texts. This interpretation is in line with both evidence that prior content knowledge affects monitoring processes in early and middle primary grades and evidence that informative texts are a less familiar text genre, compared to narrative texts, in children [26,42].

4.3. Limits and future directions

We note these pertinent limitations. First, the study sample was small, although representative of the school demographic. To mitigate for sample size, we adopted a within-subjects design and the post-hoc power analysis confirmed that our sample size ensured adequate statistical power to detect significant differences in our data. However, our findings apply to beginner readers who use digital devices at home and school but not daily. Future studies with larger samples of students who use digital devices with low, medium, and high frequency should be performed to test the generalizability of these study findings. Second, the study was correlational so it cannot directly address causal relations between the contribution of readers' comprehension monitoring skills to text comprehension in various media. In particular, the study's design did not allow us to test the directional, and possibly bidirectional, relation between comprehension monitoring and text comprehension [40]. Indeed, higher requirements for text comprehension monitoring processes imposed by different media may account for differences in text comprehension, but it might also be possible that differences in text comprehension across media may affect readers' ability to reflect on their comprehension. Only additional longitudinal studies can shed light on the development of text comprehension and relations with its components in different media in primary school and older students. A third limitation is that comprehension monitoring skills were not assessed in each of the three media as in previous investigations (e.g., [54]). Relatedly, future studies should also extend the analysis to other metacognitive skills, such as planning and evaluation, which can also impact text comprehension across different media.

Fourth, although this study contributes to our knowledge of the complexity of reading in different media, future studies should consider the role of additional text and reader characteristics. The text characteristic to be included in future investigations include longer and more ecologically valid texts (e.g., hypertexts and multimodal texts; [35]) and time frame for the task [18]. Future work should also clarify if presenting and performing a reading comprehension test as an individual activity or group activity which is closer to real-world educational scenarios, influences reading in different media. Further research on reader characteristics should shed light on the role of low-level (vocabulary and attention; [21]) and high-level components of text comprehension (i.e., knowledge of text structure). Finally, further consideration should include more information on sociocultural or environmental factors, such as exposure to digital texts and various types of digital content, as well as familiarity with text genre. For instance, we were able, at least in part, to collect information on children's exposure to technology at home and consider this information in the interpretation of our data. However, information on children's digital habits was limited and available for only some of our participants, preventing an analysis of the influence of these habits on reading comprehension in different media. Future studies might usefully combine quantitative and qualitative (e.g., observations, interviews) methodologies to collect additional information, such as the frequency of leisure activities involving digital and paper media (shared book reading; e.g., [22]). More detailed information on the content of videos watched on YouTube and exposure to different text genres on digital devices will be valuable in clarifying the mixed findings found here for literal comprehension.

4.4. Conclusions

This study has both scientific and educational significance, despite the above limitations. Specifically, we identified the following main contributions. First, the study extends knowledge in a much neglected area of research on reading: the effects of reading medium on text comprehension in young readers. Most previous research concerns older readers, mainly university students. Second, this study is amongst the first to compare readers' comprehension of linear texts across a range of media: paper, computer, and tablet. Third, to our knowledge, it is the

first to consider the contribution of metacognitive skills to reading comprehension across the three different media. The inclusion of different media is a significant methodological strength of the present work. Therefore, this study contributes to our understanding of the potential role of tablets, compared to computers, as a factor that influence digital reading comprehension. Fourth, this study contributes to the analysis of media effects on reading comprehension by considering the influence of the text genre on shallower and deeper levels of comprehension.

In discussing the strengths of the present paper, it is worth noting that we considered linear, comparable, and static texts with as few distractions as possible both in the paper and digital conditions. This choice was deemed appropriate for beginner readers and necessary to obtain experimental control in analyzing potential differences in reading comprehension across reading media. However, the use of linear and static texts in the paper and digital scenarios might have reduced the complexities of ecological digital texts, such as enhanced storybooks and hypertexts, that might contain additional distractions (e.g., links) and stimulating factors (e.g., colors). Therefore, using similar texts in paper and digital conditions might have reduced the possibility of identifying potential differences in reading comprehension across media.

According to our findings, early educational experiences at school may introduce beginner readers to texts presented not only on paper but also on digital devices, since the latter do not negatively affect children's reading comprehension. Our data also provide some more specific suggestions to inform the use of digital texts in teaching activities and the design of educational tools and reading assessments. Digital texts should preferably be presented through tablets that are more familiar to children and may reduce the manual and also cognitive load to operate the device. In addition, digital texts with a reduced number of distractions may offer beginner readers an initial digital reading experience that is closer to the print experience, supporting the application and generalization of metacognitive strategies acquired in printed texts to digital texts.

IRB Approval

The study was approved by the ethics committee of Psychological Research Area of the University of Padua (ethical approval code: 7F35AB627AB88DEF551318A3539E38EE).

CRediT authorship contribution statement

Elena Florit: Writing – original draft, Methodology, Investigation, Conceptualization. **Pietro De Carli:** Writing – original draft, Formal analysis. **Antonio Rodà:** Software, Methodology. **Kate Cain:** Writing – review & editing, Supervision. **Lucia Mason:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.caeo.2025.100243.

Appendix A

Readability and lexical properties of the texts

The readability (Gulpease index) of the six texts ranged from 77 to 83 showing that the texts were appropriate for primary school. The percentages of words that belong to Basic Vocabulary ranged from 80 % to 89 % [19] and were similar across the texts (Kurskal-Wallis Test: $\chi^2(5) = 5.00$, $p = 0.416$).

Appendix B

Examples of texts and comprehension questions

Narrative text "Little Hedgehog"

Italian version

Era autunno. Nel bosco, gli animali stavano andando in letargo. In una tana, c'era Piccolo Riccio, la sua mamma e i suoi sette fratelli.

Tutti i suoi fratelli erano pronti ad addormentarsi per andare in letargo. Piccolo Riccio invece brontolava: - Io non voglio dormire! Voglio giocare anche durante l'inverno!

Quel giorno uscì per cercare un amico con cui giocare a nascondino. Andò dal suo miglior amico, lo scoiattolo. Poi andò dal suo amico orso e poi dalla sua amica lucertola. Ma i suoi amici si stavano addormentando e non uscirono dalle tane. Piccolo Riccio era triste e tornò alla sua tana.

Nella tana i suoi fratelli dormivano. La mamma era sveglia. Lei raccontò a Piccolo Riccio una bellissima storia. Piccolo riccio si addormentò e si svegliò in primavera.

English translation

It was autumn. In the woods, the animals were hibernating. In a den, there was Little Hedgehog, his mother, and his seven brothers.

All his brothers were ready to fall asleep to hibernate. Little Hedgehog instead grumbled: - I don't want to sleep! I want to play during the winter too!

That day, he went out to find a friend to play hide and seek with. He went to his best friend, the squirrel. Then he went to his bear friend and then to his lizard friend. But his friends were falling asleep and did not come out of their holes. Little Hedgehog was sad and returned to his lair.

In the den, his brothers were sleeping. Mom was awake. She told Little Hedgehog a beautiful story. Little Hedgehog fell asleep and woke up in the spring.

Question on the main point: What is the story about?

a). A pet
b). A toy
c). Flowering trees
d). A wild animal

Literal question: How many brothers does Little Hedgehog have?

a). ten
b). one
c). seven
d). three

Inferential question: Why does Little Hedgehog grumble?

a). Because he wants to eat
b). Because he wants to play
c). Because he wants to sleep

d). Because he wants to drink

Informational text "Rossella the Turtle"

Italian version

Rossella è una tartaruga di tre anni. Ha un guscio che sembra un sasso ricoperto di muschio. Ha quattro zampe corte e una testolina che sbucano dal guscio. Il suo collo è lungo. I suoi occhi sembrano due olive nere.

Rosella vive in un piccolo recinto vicino agli attrezzi da giardino. Le piace molto scavare nella terra e stare al sole.

E' molto paurosa. Appena sente un rumore o vede un gatto che si avvicina, nasconde la testa e le zampe nel guscio. Cammina in modo molto lento. Per questo ci mette tanto tempo per andare da un lato all'altro del recinto.

Rossella ama mangiare radicchio e mele. Nel recinto c'è anche una vaschetta piena d'acqua. Quando deve bere, Rosella si immerge con tutto il corpo.

English translation

Rossella is a three-year-old turtle. It has a shell that looks like a stone covered with moss. It has four short legs and a little head that emerges from the shell. Its neck is long. His eyes look like two black olives.

Rosella lives on a small fence near the garden tools. She really enjoys digging in the soil and being in the sun.

She is very scared. As soon as she hears a noise or sees a cat approaching, she hides his head and paws in the shell. She walks very slowly. This is why she takes a long time to go from one side of the fence to the other.

Rossella loves to eat salad and apples. There is also a basin full of water on the fence. When she has to drink, Rosella immerses herself with her whole body.

Question on the main point: What is the story about?

a). An animal living in the garden
b). A cat and a mouse
c). An animal living in a pond
d). A leaf

Literal question: How is Rossella's neck?

a). Short
b). Spotty
c). Long
d). Wrong

Inferential question: Why does Rosella hide in the shell?

a). Because she wants to sleep
b). Because she is cold
c). Because she is scared
d) Because she is courageous

Data availability

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy.

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