Investigating effects of reading medium and reading purpose on behavioral engagement and textual integration in a multiple text context

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ABSTRACT

The study addressed to what extent behavioral engagement and textual integration may differ when undergraduate readers work with identical printed versus digital texts in preparation for an exam versus for pleasure. We expected that working with printed texts would lead to greater engagement and better integration than working with digital texts, but that reading purpose would moderate this effect of reading medium because those reading in preparation for an exam would display greater engagement and better integration regardless of reading medium. Results showed interaction effects of reading medium with reading purpose on the behavioral engagement indicators of reading time and the length of the post-reading written products. For reading time, the interaction involved that students used longer time when reading digital and mixed texts for an exam, compared to reading for pleasure, whereas there were no difference between exam and pleasure oriented reading when reading printed texts. For the length of the written responses, students produced more text when reading printed texts for an exam than when reading printed texts for pleasure, whereas there were no differences in text production between reading for an exam and reading for pleasure when reading digital or mixed texts. Finally, there was an indirect effect of reading purpose on textual integration via text production when students read printed texts: students who read printed texts in preparation for an exam produced longer written responses compared to those who read for pleasure and, in turn, gained a more integrated understanding of the issue in question. These results are discussed in terms of the implications they offer and the avenues they suggest for future research.

1. Introduction

In 1452, Johannes Gutenberg, a German blacksmith, revolutionized reading technology by means of the printing press, allowing for mass production of printed materials, rapid dissemination of knowledge, and exponential growth in literacy skills (Keirns, 2018). In the 550 years that followed, print conquered the world (Olson, 1994). In brief, the reading of printed texts became an essential source of knowledge acquisition, communication, and entertainment, making it difficult to counterfactually imagine a world without print.

Then, with the advent of the World Wide Web and increasing access to digitally represented information towards the end of the last century, a new reading technology came to demand center stage and the fate of printed texts suddenly became uncertain (Birkerts, 1994). After all, why print when digital texts could be created without paper production and distribution, stored without taking up physical space in homes, schools, and offices, and accessed instantaneously from personal computers. Of course, in the 21st century, digital texts have become ubiquitous and indispensable in most areas of life, including education, and accessible not only from computers and laptops but also from mobile devices such as smartphones and tablets (Kammerer, Brand-Gruwel, & Jarodzka, 2018).

Still, print has remarkably and paradoxically stood its ground in the digital age (Pew Research Center, 2018), with printed texts likely accessed in many homes, reading rooms, workplaces, and even in the offices of the readers of this article on a daily basis. In terms of the wider reading context, people could therefore be said to be in limbo, that is, an undecided condition or a period of transition as far as reading medium is concerned. It goes without saying that such a condition is fertile ground for reading researchers to compare reading across the two mediums, focusing on potential similarities and differences in the processing and comprehension of printed and digital texts.

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1.1. Reading printed versus digital texts

While the first review of studies comparing the reading of printed and digital texts was published more than a quarter century ago (Dillon, 1992), this line of research has been revitalized in the last decade by a number of intriguing empirical studies (e.g., Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012; Golan, Barzillai, & Katzir, 2018; Lauterman & Ackerman, 2014; Singer & Alexander, 2017a; Singer Trakhman, Alexander, & Berkowitz, 2019; Singer Trakhman, Alexander, & Silverman, 2018; Peterson & Alexander, in press). Taken together, these studies have indicated that readers may display better comprehension performance when reading printed texts, especially when comprehension is measured by means of more specific questions (i.e., rather than main idea questions; Singer & Alexander, 2017a; Singer Trakhman et al., 2018, 2019). Further, readers have been found to misjudge their comprehension more often in the digital medium and to struggle with metacognitive regulation (Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012). The advantage of reading in print indicated by these studies has also been highlighted in several updated reviews of the literature (Clinton, 2019; Delgado, Vargas, Ackerman, & Salmerón, 2018; Kong, Seo, & Zhai, 2018; Singer & Alexander, 2017b).

In a narrative review of 36 empirical studies conducted between 2001 and 2017, Singer and Alexander (2017b) highlighted the great variability in how text comprehension was measured across studies. Moreover, these authors, based on their review, suggested that there was an association between text length and reading medium, with text comprehension seemingly better in the print medium when the texts were longer (≥ 500 words or ≥ 1 page) but not when the texts were shorter (≤ 500 words or ≤ 1 page). In conclusion, Singer and Alexander (2017b) called for future research on different levels of comprehension and how the effects of reading medium on comprehension might be moderated by other factors.

When Delgado et al. (2018) examined research from the period 2000–2017 that compared the reading of printed and digital texts with respect to comprehension performance, their meta-analysis showed an advantage for printed texts (Hedge's $g = -0.21$, $d_c = -0.21$). Of note is that this meta-analysis included 38 between-participants and 16 within-participants studies and that only comparisons where the texts were similar except for the reading medium were analyzed. Similar effect sizes in favor of printed texts were recently obtained in smaller meta-analyses by Kong et al. (2018) and Clinton (2019). With respect to moderating variables, Delgado et al. (2018) found that the advantage of printed texts increased when the reading time was constrained, when participants read informational texts, and when the studies were published or presented more recently. Their comprehensive meta-analysis did not confirm that text length was a moderator of reading medium effects, however.

A viable hypothesis for explaining the observed advantage of printed texts is the shallowing hypothesis (Annisette & Lafreniere, 2017). This hypothesis suggests that people typically process digital texts more shallowly or superficially because their use of digital media, which often involves quick interactions driven by immediate rewards, promotes a habit of mind that is not conducive to performing more challenging tasks requiring sustained attention, such as text comprehension. This notion is also supported by findings showing that readers process digital texts faster than comparable printed texts (Singer Trakhman et al., 2018, 2019). While Singer Trakhman et al. (2019) suggested that processing time may mediate the effect of reading medium on readers' calibration as well as comprehension, with readers of digital texts tending to read faster and, in turn, overestimate their performance and obtain poorer comprehension, research by Ackerman and colleagues (Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012; Lauterman & Ackerman, 2014) suggests that the relationship between processing time and calibration may be bidirectional. Thus, in a series of studies comparing undergraduates' reading of identical printed and digital texts, Ackerman and colleagues (Ackerman &

Goldsmith, 2011, Exp. 1; Lauterman & Ackerman, 2014) found that when reading digital texts, students tended to overestimate their comprehension. As a likely consequence of this overestimation, students also spent less time reading and achieved poorer comprehension when reading digital texts (Ackerman & Goldsmith, 2011, Exp. 2). In any case, more inaccurate judgment of their actual level of comprehension as well as less investment of time and effort when readers work with digital as opposed to printed texts seem consistent with the reading medium differences with respect to comprehension that have been observed in recent research.

It follows from the shallowing hypothesis that inducing readers to process digital texts more deeply could alleviate the negative effects of the digital medium on comprehension performance (Delgado et al., 2018; Singer Trakhman et al., 2018). Accordingly, previous studies have suggested that promoting deeper processing through approaches such as summary writing and framing the task as central may reduce or eliminate reading medium differences in comprehension (Lauterman & Ackerman, 2014; Sidi, Shpigelman, Zalmanov, & Ackerman, 2017). Building on a long line of research on the effects of reading purpose on text processing and comprehension, we took a different tack in the current study and investigated whether reading in preparation for an exam versus reading for pleasure would moderate likely effects of reading medium on processes and products of reading.

1.2. The role of reading purpose

The idea that readers' text processing and comprehension are influenced by the purpose for reading is anchored in several theoretical accounts of the reading process (Britt, Rouet, & Durik, 2018; McCrudden & Schraw, 2007; Pressley & Afflerbach, 1995). For example, in the goal-focusing model of McCrudden and Schraw (2007), readers interpret instructions to read for a particular purpose and adapt their processing to this interpretation, investing time and effort in activities judged to help them achieve that purpose and, consequentially, constructing an understanding that fits that purpose.

An important component of purposeful reading may concern readers' standards of coherence (Britt et al., 2018; Linderholm, 2006). This construct refers to the criteria or benchmarks for coherent understanding that readers adopt, and against which they assess the constructed coherence during reading (van den Broek, Bohn-Gettner, Kendeou, Carlson, & White, 2011; van den Broek, Risden, & Husebye-Hartmann, 1995). Presumably, readers may raise or lower their standards of coherence depending on the reading purpose, with such varying standards of coherence likely to influence the ways texts are processed and understood (Britt et al., 2018; Linderholm, 2006).

Much research in this area has contrasted the reading purposes of reading in preparation for an exam and reading for pleasure (e.g., Bohn-Gettner & Kendeou, 2014; Linderholm & van den Broek, 2002; Narvaez, van den Broek, & Ruiz, 1999; Salmerón, Kintsch, & Kintsch, 2010; van den Broek, Lorch, Linderholm, & Gustafson, 2001). In general, this research has demonstrated that students asked to imagine themselves reading in preparation for an exam engage in more coherence-building processing during reading and perform better on post-reading tests about text content, compared to readers asked to imagine themselves reading for pleasure. Of note is that the only difference between the reading purpose conditions in these studies was that participants were asked to imagine themselves reading for a particular purpose. Still, their findings are consistent with the view that reading in preparation for an exam may raise readers' standards of coherence and make them process texts more deeply to meet those standards. To the best of our knowledge, no prior study has experimentally investigated whether reading purpose may moderate the effects of reading medium on reader engagement and comprehension, however. Moreover, no prior study has investigated the extent to which reading medium and reading purpose, independently and interactively, may influence reader engagement and performance in a multiple text context.

1.3. Behavioral engagement in multiple text reading tasks

Reading more than one text to learn about a particular topic or issue seems to be the rule rather than the exception in information-rich 21st century learning environments (Braasch, Bråten, & McCrudden, 2018a). However, as noted by Bråten, Brante, and Strømsø (2018), lack of engagement is often an issue when students are asked to perform complex multiple text reading tasks. This highlights the importance of trying to identify the antecedents of reader engagement when working on such tasks.

Engagement is a multidimensional construct including behavioral, emotional, and cognitive dimensions (Ben-Eliyahu, Moore, Dorph, & Schunn, 2018; Sinatra, Heddy, & Lombardi, 2015; Skinner, Pitzer, & Brule, 2014), which can be addressed at different levels ranging from person-oriented to context-oriented levels of engagement (Sinatra et al., 2015). In the present study, we focused on the dimension of behavioral engagement, which concerns participation in learning activities observable through learners' effort, exertion, time, and persistence (Guthrie & Klauda, 2016; Guthrie, Wigfield, & You, 2012; Sinatra et al., 2015; Skinner et al., 2014). Moreover, we addressed behavioral engagement at a person-oriented level, concerning the individual learner's engagement with a particular task (Sinatra et al., 2015).

In multiple text reading contexts, behavioral engagement may be operationalized in different ways, such as the time students use to select texts and the number of texts they select, the number of times they revisit texts and their total reading time, and the time they devote to writing from multiple texts and the length of their written products (Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Bråten, Brante, & Strømsø, in press; Bråten et al., 2018; Goldhammer et al., 2014; List & Alexander, 2018a; List, Stephens, & Alexander, 2019). In particular, reading time and the length of the written products have been found to be valid indicators of behavioral engagement when students work on multiple text tasks.

Thus, reading time has been found to be a positive predictor of performance on multiple text tasks among undergraduate and upper-secondary school students when other relevant motivational and cognitive individual difference variables have been controlled for (Bråten et al., 2014, 2018; List et al., 2019; see also, Goldhammer et al., 2014). Moreover, longer time spent on reading multiple texts has resulted from training to promote upper-secondary school students' multiple text reading skills (Bråten et al., in press). With respect to the length of the written products, this variable has been found to be a strong positive predictor of performance on multiple text tasks (Bråten et al., 2018), as well as an outcome of training in a multiple text context (De La Paz et al., 2016).

Thus, although reading time and text production, of course, do not guarantee that students are always actively investing time and effort into multiple text tasks (they could sometimes be mind-wandering or carelessly producing meaningless text), there is evidence to support the idea that reading time and text production may be valid indicators of behavioral engagement in multiple text contexts. Previously, these indicators have not been investigated in relation to reading medium and reading purpose, however.

1.4. Integration across multiple texts

In several studies comparing the reading of printed and digital texts, Singer Trakhman and colleagues (Singer & Alexander, 2017a; Singer Trakhman et al., 2018, 2019) have found that the advantage for printed texts may vary with the level of specificity at which comprehension is measured. Thus, students have been found to perform better in the printed than in the digital medium when asked to recall key points and other relevant information units, but not when asked to report their global understanding in the form of a transparent main idea. None of these studies have compared the reading of printed and digital texts with respect to building an integrated understanding across texts,

however, which seems like an important next step in investigating which types of comprehension distinguishes between reading on paper and digitally.

When individuals read more than one text to learn about a particular topic or issue, integration across texts is a major challenge (Cho & Afflerbach, 2017; List & Alexander, 2018b, 2019; Magliano, McCrudden, Rouet, & Sabatini, 2018; van den Broek & Kendeou, 2015). In general, integrated understanding in multiple text contexts involves linking content information across different texts in the service of meaning-making (Barzilai, Zohar, & Mor-Hagani, 2018). More specifically, when multiple texts present conflicting information on the same topic or issue, building integrated understanding involves drawing bridging inferences across conflicting accounts to achieve conflict resolution or reconciliation (Braasch & Bråten, 2017). However, when multiple texts present complementary information (i.e., when information across different texts is part of a larger whole not specified in any single text), building integrated understanding involves combining supplemental information across texts to achieve a more complete understanding (List & Alexander, 2018b).

In their recent review of instructional approaches to promote integration of multiple texts, Barzilai et al. (2018) reported that text integration most commonly was measured by means of written essays, intertextual verification tasks, and open-ended integrative questions. Further, these authors noted that in less than 5% of the studies they reviewed were integration of complementary information across texts the focus of attention, which may seem somewhat remarkable given the ubiquity of this task in educational contexts.

A range of individual and contextual factors has been studied in relation to multiple text comprehension (Braasch, Bråten, & McCrudden, 2018b). Thus far, neither reading medium nor the "maximally distinctive" reading purposes of reading in preparation for an exam versus reading for pleasure are among them. Addressing the potential effects of these factors on integration across complementary texts therefore represents unique extensions of prior research on multiple text reading as well as on the effects of reading medium and reading purpose.

1.5. Controlling for individual differences

Given our focus on reading medium and reading purpose rather than individual differences in this study, we wanted to control for the potential influences of reading comprehension skills, need for cognition, perceived prior knowledge, and cognitive reflection. These variables were considered relevant covariates because prior research has indicated that they may be associated with engagement as well as integration in multiple text contexts (e.g., Bråten et al., 2014; Kammerer, Meier, & Stahl, 2016; Strømsø, Bråten, & Stenseth, 2017). In particular, assessing reading comprehension seems essential to partial out the effects of reading skills on participants' reading time and text integration. Moreover, general engagement in and enjoyment of complex tasks (i.e., need for cognition; Petty, Briñol, Loersch, & McCaslin, 2009) may potentially influence engagement as well as text integration, as may prior knowledge about the topic of the texts. Finally, a disposition towards reflection and rational thinking (i.e., cognitive reflection; Frederick, 2005) is likely to make readers invest more time and effort in task performance and achieve a higher-quality mental representation of text content.

1.6. The present study

Given this theoretical and empirical backdrop, we set out to investigate to what extent reader engagement and comprehension may differ when readers work with identical printed versus digital texts. In terms of engagement, we focused on behavioral engagement, which refers to the investment of time and effort in learning activities (Sinatra et al., 2015) and in relation to reading can be measured by the time

used for reading and the effort and persistence put into reading assignments (Guthrie & Klauda, 2014, 2016; Guthrie et al., 2012). Accordingly, we used the time readers used for processing the texts (i.e., reading time) as well as their productivity when responding to the reading task (i.e., the length of the written responses) as indicators of behavioral engagement in the present study (cf., Bråten et al., 2018). In terms of comprehension, we focused on readers' integration of complementary information across two separate texts, with participants randomly assigned to a print condition where both texts were printed, a digital condition where both texts were digital, or a mixed condition where one text was printed and the other digital.

Based on previous research on the effects of reading medium on text processing and comprehension (e.g., Ackerman & Goldsmith, 2011; Delgado et al., 2018; Singer Trakhman et al., 2018, 2019), and the shallowing hypothesis assumed to explain those findings (Annisette & Lafreniere, 2017; Delgado et al., 2018), we expected that participants who read both texts in print would not only engage more in the assignment than participants who read both texts digitally, as evidenced by longer reading time and more extensive responses, but also outperform participants who read both texts digitally with respect to cross-text integration. Of note is that we included the mixed condition for exploratory reasons, without being able to ground specific hypotheses regarding the comparative effects of this reading medium condition in prior research and theory.

At the same time, however, we expected that the effects of reading medium on reader engagement and text integration would be moderated by reading purpose, with participants within each reading medium condition randomly assigned to read the two texts either to prepare for an exam or for pleasure. Following previous work regarding the effects of reading purpose (Linderholm, 2006), we asked participants to imagine themselves reading for the purpose of exam preparation versus for pleasure. Based on prior research showing that reading in preparation for an exam may lead to deeper level processing and better comprehension performance than reading for pleasure (e.g., Bohn-Gettner & Kendeou, 2014; Linderholm & van den Broek, 2002), and the theory of standards of coherence used to explain such findings (Britt et al., 2018; Linderholm, 2006), we expected that differences between print and digital mediums would be substantially reduced or even eliminated when participants read in preparation for an exam. This is because participants reading in preparation for an exam could be expected to raise their standards of coherence and, accordingly, engage more in the assignment and obtain better text integration regardless of reading medium condition. Again, we found it difficult to ground any specific hypotheses concerning the mixed condition in prior research and theory. Still, because reading a mixture of printed and digital texts can be considered a hallmark of what we call "reading in limbo," we found it pertinent to explore the independent and interactive effects of this reading medium condition in the present research (see also, Peterson & Alexander, in press).

By including reading comprehension, need for cognition, perceived knowledge, and cognitive reflection as covariates in the present study, we wanted to ensure that any effects of our experimental manipulations of reading medium and reading purpose occurred independently of these individual difference variables.

2. Method

2.1. Participants

Participants were 133 undergraduates enrolled in the first and second years of a bachelor program in education (46%) or special needs education (54%) at a university in southeast Norway. The mean age of the participants was 23.11 years ($SD = 3.78$) and 87% were female. The vast majority (82%) had Norwegian as their first language, and the rest were bilingual. Most of the participants (53%) had studied for at least one year after finishing upper-secondary school, whereas 47% had no

study experience at postsecondary level before starting on the bachelor program. Regarding reading medium preferences, participants were reportedly more likely to prefer reading printed texts in the study context ($M = 4.22$, $SD = 1.06$) than in their leisure time ($M = 3.39$, $SD = 1.06$), $t(1\,2\,9) = 6.75$, $p < .001$, Cohen's $d = 0.68$.[1]

Participants were recruited from large regular lectures and volunteered to participate in the study. They received a gift card worth NOK 200 (approx. USD 25) for their participation. Collection and handling of all data met the requirements of the Personal Data Registers Act and were approved by the Norwegian Social Science Data Services.

2.2. Materials

2.2.1. Texts and experimental manipulations

Each participant read two separate expository texts on the use of social media. One text was titled *Social Media – Friend or Foe?*; the other *Social Media = Social People?*. The texts were assembled from various authentic texts on the issue, including media science bachelor level textbooks and diverse popular science articles. We adapted these textual materials with respect to language, length, and intratextual cohesion, as well as with respect to the interrelationships between different paragraphs across texts. At the beginning of each text, just above the title, source information was presented in the form of publication, date of publication, and author's name and credentials. Specifically, both texts were presented as taken from the online version of a serious Norwegian newspaper (Aftenposten.no), published in late March 2018, and authored by two female journalists with common Norwegian names. The two texts were similar in length (viz., 760 and 762 words) and readability (viz., 50 and 43), with the readability estimates, which were based on Björnsson's (1968) formula, indicating that the texts were comparable to the difficulty level of information texts from the Norwegian government (Vinje, 1982).

Each text consisted of an introductory paragraph (approx. 100 words), followed by four paragraphs (approx. 150 words each) and a brief conclusion (approx. 50 words). The four middle paragraphs of the two texts presented information on different aspects of social media use: (a) psychological aspects of social media use, (b) differences in social media use related to educational level, (c) the potential effects of social media use on friendships, and (d) gender differences in social media use. The information presented in each of the four paragraphs of one text complemented information about the same aspect of social media use presented in a paragraph of the other text, such that combining information across the texts were required to gain a more complete understanding of each aspect.

Thus, regarding psychological aspects, one paragraph in one text explained that the use of social media may lead to upward social comparison with people who portray themselves as unrealistically happy and successful, while the complementary paragraph in the other text explained that people may feel more socially isolated and lonely the more they use social media. Regarding the aspect of educational level differences, one paragraph in one text described how people with higher education typically use social media, while the complementary paragraph in the other text described how people with lower education typically use social media. Regarding the aspect of potential effects on friendships, one paragraph in one text described how the use of social media makes it easier to make new friends, while the complementary paragraph in the other text explained that the quality of online friendships may differ from that of real life friendships. Finally, regarding gender differences, one paragraph in one text described how women typically use social media, while the complementary paragraph

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[1] On a demographic survey, participants rated their preference for reading medium when reading in the study context and in their leisure time, respectively, on a scale ranging from 1 to 5 (1 = clear preference for digital texts, 5 = clear preference for printed texts).

in the other text described how men typically use social media.

To measure text integration (see *Dependent measures* below), participants were asked one integrative question about each of the four aspects of social media use discussed across texts, with scores reflecting the extent to which they combined information from the two texts in their written responses. English versions of both texts are presented in Appendix A.

The reading purpose was manipulated between participants, such that participants (randomly assigned) were instructed to read both texts either in preparation for an important exam or for pleasure (see *Procedure* below). Further, we manipulated the reading medium between participants, such that participants (randomly assigned) read both texts in print, both texts on screen, or one text in print and the other one on screen. In the print condition, both texts were printed single spaced on two A4 (8.3 × 11.7 in.) sheets of paper that were stapled together, using 12 point Verdana. In the digital condition, participants read both texts as PDF files with Adobe Reader on a 15.1″ laptop with an LCD monitor at a resolution of 1366 × 768 pixels and a font size equivalent to 12-points size. Eighteen out of 72 and 76 text lines, respectively, were available on the screen at once, with the rest of the content accessible by vertical scrolling. Finally, in the mixed (i.e., print and digital) condition, one of the texts was presented as in the printed condition, whereas the other was presented as in the digital condition.

2.2.2. Dependent measures

In the following, we describe our three dependent measures: reading time, the length of the written responses, and text integration. Regarding text integration, we also describe the scoring system and how interrater reliability was established.

2.2.2.1. Reading time.
To compute the reading time, a stop watch was started when participants began reading, with the time for each participant registered when he or she finished reading the first as well as the second text. Although reading time was registered for each text, only the total reading time for both texts was used in further statistical analyses. Of note is that participants were not explicitly informed that the reading time was monitored and that the registration was done with discretion.

2.2.2.2. Response length.
To compute response length, we counted the number of words in participants' written responses to each of the four integrative questions. In further statistical analyses, participants' total response length was used as a dependent measure, indicating the amount of effort they invested in their written task products (cf., Bråten et al., 2018).

2.2.2.3. Text integration.
To assess integration of information across the two texts, we asked participants to respond in writing to one question concerning each of the aspects discussed across texts. The first question, concerning psychological aspects, was: *Can people's presentation of themselves in social media make a difference to the mental health of the users of social media*? The second question, concerning educational level, was: *Is there any connection between education and the use of social media*? The third question, concerning the potential effects of social media use on friendship, was: *Can the use of social media affect friendships in any way*? Finally, the fourth question, concerning gender differences, was: *Is there any connection between gender and the use of social media*?

Responses were scored according to whether participants described the aspects as represented within the paragraphs of each text and integrated information concerning those aspects across texts, with scores on each question ranging from 0 (no response or irrelevant information) to 3 (describing an aspect [e.g., gender differences] as represented within the corresponding paragraphs of the two texts as well as integrating information about that aspect across texts). Scores of

1 and 2 were awarded, respectively, when participants described an aspect as represented within one of the texts (1) or as represented within both of the texts (2) without integrating information about that aspect across the two texts.

Adapting the system used by Taylor, Lawrence, Connor, and Snow (2019) for assessing the integration of written products, we coded cross text integration as indicated by participants' use of connective words, in particular the use of causal and adversative connectives (Halliday & Hasan, 1976). Thus, causal connectives such as *because*, *consequently*, *hence*, *since*, and *therefore* signaled that participants combined information across the two texts in order to provide a more complete explanation of a particular aspect of social media use, while adversative connectives such as *however*, *in contrast*, *on the other hand*, *whereas* signaled that participants combined information across the two texts in order to compare and contrast and, in turn, get a more complete overview of the aspect in question. The system for scoring the written responses is further described and exemplified in Appendix B.

The first and second authors, blind to experimental conditions, scored the written responses of all participants. First, the responses of 30 participants were scored in collaboration. Next, a random selection of 26 participants' responses (i.e., 20%) were independently scored, resulting in 78% agreement. The correlation (Pearson's r) between the raters' total scores for the 26 participants was 0.79. Disagreements were solved in thorough discussion, and the responses of the rest of the participants were scored by these two authors separately. The possible range of scores on the entire text integration measure was 0–12 and only these total scores were used in subsequent statistical analyses.

2.2.3. Covariates

In the following, we describe the four measures included as potential covariates in the present study, that is, measures addressing reading comprehension, need for cognition, perceived prior knowledge, and cognitive reflection.

2.2.3.1. Reading comprehension measure.
To assess reading comprehension, we used a Norwegian adaptation of a cloze comprehension test developed by Gellert and Elbro (2013). This test has been validated with Danish adults and young adults by Gellert and Elbro (2013) and with Norwegian upper-secondary school students by Bråten et al. (2018). For example, Gellert and Elbro (2013) demonstrated that scores on this measure are highly correlated with scores on standardized question-answering tests of reading comprehension. This measure consisted of five narrative and five expository texts ranging from 40 to 330 words, with a total of 1340 words. The texts contained 41 word gaps in total, with four alternative words provided for each gap. Correct refilling of the gaps could only be achieved by drawing bridging inferences. Participants read the texts and refilled as many gaps as possible during a period of 10 min. The scoring involved counting the number of correctly refilled gaps. The reliability estimate (Cronbach's α) for participants' scores on this measure was 0.83.

2.2.3.2. Need for cognition measure.
To measure participants' need for cognition, we used a Norwegian version of the 20-item Rationality subscale of the Rational-Experiential Inventory (REI), which was constructed and validated by Pacini and Epstein (1999). The Norwegian version has previously been validated by Bråten et al. (2014) and by Bråten and Ferguson (2014). Essentially, the Rationality subscale is a shorter, modified version of the Cacioppo and Petty (1982) Need for Cognition (NFC) scale, assessing engagement in and enjoyment of cognitive activities. Each item was rated on a 10-point scale (1 = not at all true for me, 10 = completely true for me). Scores on the measure were divided by the number of items so that they ranged from 1 to 10. The reliability estimate (Cronbach's α) for participants' scores was 0.86.

2.2.3.3. Perceived prior knowledge. As a proxy for prior knowledge, we constructed a measure consisting of six items to assess participants' perceived knowledge of or familiarity with the topic of social media. That is, participants rated their knowledge about (1) how social media store and use personal data, (2) similarities and differences between various social media, (3) advantages and disadvantages of using social media, (4) different types of social media and their respective users, (5) how social media are used to convey news, and (6) how social media are used in marketing products and services. On all items, participants rated their agreement with the knowledge statements ("I have knowledge about …") on a 10-point scale (1 = disagree completely, 10 = agree completely). The reliability estimate (Cronbach's α) for participants' scores on the measure was 0.83. Moreover, a maximum likelihood factor analysis with oblique rotation showed that all six items loaded on one single factor and thus represented the same underlying construct. Of note is that prior research has found perceived knowledge to be a quite good indicator of students' scores on knowledge measures (Stanovich & West, 2008) and to play an important role in their judgments of new information (Andiliou, Ramsay, Murphy, & Fast, 2012).

2.2.3.4. Cognitive reflection test. The Cognitive Reflection Test (CRT; Frederick, 2005) is designed to assess problem solving in terms of overriding a prepotent intuitive response alternative that is incorrect and engaging in further reflection and rational thinking that lead to the correct response (Toplak, West, & Stanovich, 2014). As such, the CRT is considered to require deeper-level self-regulatory processing (Kahneman, 2011; Kahneman & Frederick, 2007; Toplak, West, & Stanovich, 2011), and scores on the CRT have been shown to correlate substantially with other measures of skills in rational thinking and to predict rational thinking performance after variance accounted for by cognitive ability and diverse thinking dispositions (e.g., need for cognition) has been partialled out. A Norwegian adaption of the CRT was developed by Strømsø and Bråten (2017) and further validated by Bråten, Lien, and Nietfeld (2017).The test is composed of three numerical problem tasks (sample item: "A bat and a ball cost NOK 110 in total. The bat costs NOK 100 more than the ball. How much does the ball cost?"). Participants were awarded 1 point for each correct answer. Cronbach's α reliability for participants' scores was 0.76.

2.3. Procedure

Data were collected in one 60-min session in a quiet room at the university, with all materials administered by the first author in groups of maximum five participants, all within same experimental condition. First, participants received a folder containing the reading comprehension measure, a brief demographic survey, the need for cognition measure, the perceived prior knowledge measure, and the cognitive reflection test, and completed these tasks in this order on paper. When finished, participants received a new folder containing a reading instruction on a sheet of paper. All participants were informed that they would read two texts about social media taken from a series of recently published articles on the topic. In addition, the instruction for participants assigned the purpose of reading in preparation for an exam was: "Imagine that you are sitting concentrated in the reading room and read these texts in preparation for an exam on the use of social media. Imagine that this is an important exam on which you want to do your best." The participants assigned the purpose of reading for pleasure were instructed: "Imagine that you are sitting relaxed at home and read these texts about the use of social media for pleasure. Imagine you have chosen these texts because you find the topic interesting." [2]

Beneath the reading instruction, participants were informed how they could access the two texts. The participants assigned to reading both texts in print were informed that the texts were available in a cover within the same folder, on two separate sheets of paper. The participants assigned to reading digital versions of the texts were informed that the texts were available in a folder located on the desktop of the computer (a HP Probook 4510) on the table in front of them. The folder was labeled Texts, and by clicking on this folder, two PDF files containing the two texts appeared in File Explorer of Windows 7 Professional. The participants assigned to reading one text in print and the other one on screen were informed that one text was available in a cover within the same folder and that the other text was available in a folder located on the desktop of the computer (as in the digital condition described above). In all three medium formats (i.e., print, digital, and mixed), one of the texts was labeled Text 1 and the other text was labeled Text 2, with this order counterbalanced across participants. In addition, in the mixed condition, the order of the mediums (i.e., print and digital) was counterbalanced across participants.

Although participants were instructed to read the text labeled Text 1 before the text labeled Text 2, they could return to previously read texts and thus go back and forth between the two texts in all experimental conditions (e.g., by flipping back and forth between the two stapled, printed texts or going between the two desktop folders including the digital texts). Also, participants could manipulate the texts so that they could view both texts simultaneously, for example, by ripping out the staple and putting the texts side by side in the print condition, by adjusting the size of the texts and putting them next to each other on the screen in the digital condition, and by viewing the printed text on the table simultaneously with the digital text on the screen in the mixed condition. Finally, participants could mark up the texts in all experimental conditions, using a pen and/or the Adobe Reader (the pen could also be used to take notes in all conditions). [3]

Participants were allowed to use maximum 15 min for reading the texts, with pilot testing indicating that this time frame would not create any ceiling effect. After having finished reading the texts, participants handed in the folders and received the following instruction on a sheet of paper regardless of experimental condition: "You will now answer four questions about the content of the texts you just read. On the screen in front of you, you will find a link to the questions. Answer all questions as completely as possible based on what you have read."

Beside the text folder on the computer desktop, a Word file containing a link to a web based questionnaire was located (https://skjema.uio.no/99796). This questionnaire contained the four integration questions presented above. Under each question, participants wrote their response to that question in a separate text entry box with no word limit. Participants were allowed to use maximum 20 min for answering the questions, and they could not reaccess the two texts while answering the questions. After participants had completed the questionnaire, they submitted their response to a server by clicking on a "Send" button.

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[2] To further contextualize the reading purpose, participants assigned different reading purposes were also shown photos of students in different reading situations on a large monitor (65″, 1920 × 1080 pixels) located on one of the

(*footnote continued*)

walls in the room. Thus, participants assigned the purpose of reading in preparation for an exam were shown a photo of a student reading concentrated in a reading room, while participants assigned the purpose of reading for pleasure were shown a photo of a student reading relaxed in a sofa at home. In the print condition, the students in the photos were reading printed books; in the digital condition, the students in the photos were reading on laptops; and in the mixed condition, the students in the photos were reading books as well as on laptops. Participants were orally instructed to look at the photos before starting to read and the photos were visible while they performed the reading and writing tasks.

[3] Unfortunately, we did not record the extent to which participants returned to previously read texts or manipulated them physically or digitally to view both texts simultaneously. However, none of the participants marked up the texts or took notes in any condition.

Table 1
Descriptive statistics and zero-order correlations for all measured variables.

Variable	1	2	3	4	5	6	7
1. Cognitive reflection test	–						
2. Need for cognition	0.136	–					
3. Reading comprehension	0.403**	0.068	–				
4. Perceived prior knowledge	−0.203*	0.008	0.017	–			
5. Reading time	0.028	0.056	−0.453**	−0.008	–		
6. Response length	0.071	0.097	0.216*	0.025	−0.079	–	
7. Text integration	0.292**	0.146	0.457**	−0.002	−0.100	0.375**	–
M	1.02	6.78	27.11	7.62	503.14	246.89	5.54
SD	1.17	1.12	6.04	1.38	119.63	87.37	2.40
Skewness	1.61	−0.22	−0.01	−0.76	0.93	0.07	−0.08

Note. * $p < .05$, ** $p < .01$.

3. Results

Descriptive statistics and zero-order correlations for all measured variables for the entire sample are shown in Table 1. As can be seen, all scores were approximately normally distributed and thus suitable for parametric statistical analyses. Regarding correlations, reading comprehension was negatively related to reading time ($r = −0.453$, $p < .01$) and positively related to response length ($r = 0.216$, $p < .05$) as well as text integration ($r = 0.457$, $p < .01$). Moreover, scores on the cognitive reflection test were positively related to text integration ($r = 0.292$, $p < .01$). The positive correlation between response length and text integration ($r = 0.375$, $p < .01$) indicated that participants who produced longer written responses to the integration questions were also more likely to integrate information across the two texts.

Descriptive information about the scores on the covariates (i.e., reading comprehension, need for cognition, perceived knowledge, and cognitive reflection) for subgroups differing with respect to reading purpose and reading medium is shown in Appendix C. Neither need for cognition, nor perceived prior knowledge, were included as covariates in further statistical analyses. Covariates are included either to remove variance in dependent variables associated with the covariates or to remove group differences on the covariates (Field, 2018; Tabachnick & Fidell, 2014). However, need for cognition and perceived prior knowledge were not correlated with any of the dependent variables (see Table 1). Further, there were no differences between the experimental groups on any of the covariates (see Appendix C).

To address our hypotheses, we planned to perform three separate 2 × 3 between-subjects analyses of covariance (ANCOVAs) with reading purpose (exam, pleasure) and reading medium (print, digital, mixed) as the independent variables. In the analyses using reading time and response length, respectively, as the dependent variables, we planned to include the reading comprehension measure as a covariate, and in the analysis using text integration as the dependent variable, we planned to include the cognitive reflection test as well as the reading comprehension measure as covariates. Results of the evaluation of the assumptions for performing ANCOVAs were satisfactory with respect to normality and homogeneity of variance. However, the assumption of homogeneity of the regression slopes was violated for the analysis using reading time as the dependent variable. Specifically, there were different correlational patterns for reading comprehension and reading time among the subgroups. We therefore replaced this ANCOVA with the alternative blocking procedure recommended by Tabachnick and Fidell (2014), which involves grouping participants according to their scores on the covariate and using this new variable as an additional independent variable in a factorial analysis of variance (ANOVA). This makes it possible to focus on the main effects and interactions of interest (i.e., those involving reading purpose and reading medium) because variation due to the potential covariate is removed from the estimate of error variance (Tabachnick & Fidell, 2014). Accordingly, we created a new independent variable with three levels (low, medium, high), using percentiles of 33 and 66 as cut-off points for the reading comprehension measure. We then performed an ANOVA with reading purpose (exam, pleasure), reading medium (print, digital, mixed), and reading comprehension (low, medium, high) as independent variables and reading time as the dependent variable, The ANCOVAs using response length and text integration as dependent variables were performed as originally planned. When performing multiple comparisons, we used Holm's (1979) sequential Bonferroni correction to protect against Type 1 error.

In the ANOVA using reading time as the dependent variable, neither the effect of reading purpose (exam: $M = 516.47$, $SD = 160.16$; pleasure: $M = 481.72$, $SD = 166.58$; $F(1, 115) = 3.01$, $p = .09$, $\eta^2 = 0.03$), nor the effect of reading medium (print: $M = 501.40$, $SD = 197.67$; digital: $M = 475.74$, $SD = 211.80$; mixed: $M = 520.15$, $SD = 190.34$; $F(2, 115) = 1.62$, $p = .20$, $\eta^2 = 0.03$), were statistically significant. A statistically significant interaction between reading purpose and reading medium was observed on reading time, however, with $F(2, 115) = 4.19$, $p = .02$, $\eta^2 = 0.07$. Tests of the simple effects of reading purpose within each level of reading medium showed that there were statistically significant reading purpose mean differences on reading time for the digital and mixed reading mediums, with $F(1, 115) = 4.13$, $p = .04$, $\eta^2 = 0.04$, for the digital medium, and $F(1, 115) = 5.33$, $p = .02$, $\eta^2 = 0.04$, for the mixed mediums, whereas there was no statistically significant difference for the print medium, with $F(1, 115) = 1.84$, $p = .18$, $\eta^2 = 0.02$. Thus, participants who read in preparation for an exam ($M = 513.07$, $SD = 293.27$) used statistically significantly longer time than participants who read for pleasure ($M = 438.41$, $SD = 305.65$) when the texts were digital. Also, participants who read in preparation for an exam ($M = 558.25$, $SD = 270.93$) used statistically significantly longer time than participants who read for pleasure ($M = 482.05$, $SD = 267.32$) when the texts were in mixed mediums. However, when the texts were in print, participants who read for an exam ($M = 478.10$, $SD = 267.32$) did not differ statistically significantly from those who read for pleasure ($M = 524.69$, $SD = 291.25$) in regard to reading time. Tests of the simple effects of reading medium within each level of reading purpose showed that there were statistically significant reading medium mean differences on reading time for participants who read the texts in preparation for an exam, $F(2, 115) = 2.96$, $p = .05$, $\eta^2 = 0.05$, while these differences did not quite reach a conventional level of statistical significance for participants who read for pleasure, $F(2, 115) = 2.78$, $p = .07$, $\eta^2 = 0.05$. Paired comparisons showed that when reading in preparation for an exam, participants who read the texts in mixed mediums ($M = 558.25$, $SD = 270.93$) used statistically significantly longer time than those who read the texts in print ($M = 478.10$, $SD = 267.32$; $p = .02$, Cohen's $d = 0.30$), whereas there were no statistically significant differences between those who read mixed texts and those who read digital texts ($M = 513.07$, $SD = 293.27$; $p = .19$, Cohen's $d = 0.16$), or between those who read digital and printed versions of the texts ($p = .31$, Cohen's $d = 0.13$). When reading for pleasure, participants who read the texts in print ($M = 524.69$, $SD = 291.25$) used statistically significantly longer time than those who read digital texts ($M = 438.41$,
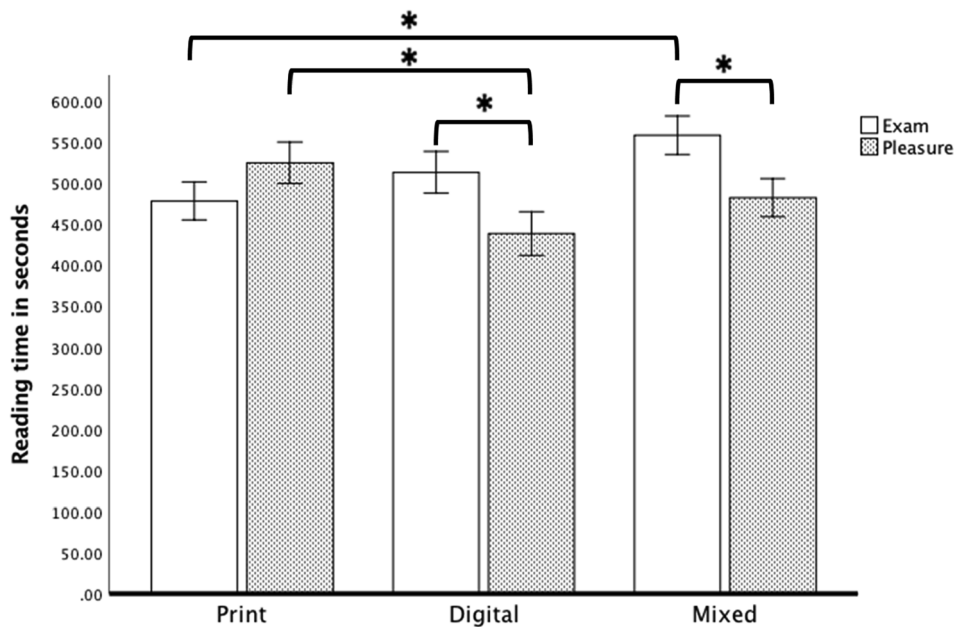
Fig. 1. Means for reading time for each reading medium by reading purpose. Error bars represent standard errors.

$SD = 305.65$; $p = .02$, Cohen's $d = 0.29$). However, there were no statistically significant differences between those who read printed texts and those who read mixed texts ($M = 482.05$, $SD = 267.32$; $p = .22$; Cohen's $d = 0.15$), or between those who read mixed texts and those who read digital texts ($p = .22$, Cohen's $d = 0.15$). Finally, reading comprehension was statistically significantly associated with reading time, with better comprehenders displaying shorter reading times than did poorer comprehenders, with $F(2, 115) = 12.37$, $p < .001$, $\eta^2 = 0.18$. Fig. 1 shows the means for participants' reading time scores for each reading medium by reading purpose.

In the ANCOVA using the length of the written response as the dependent variable, neither the effect of reading purpose (exam: $M = 254.39$, $SD = 120.23$; pleasure: $M = 238.21$, $SD = 119.35$; $F(1, 126) = 1.21$, $p = .27$, $\eta^2 = 0.01$), nor the effect of reading medium (print: $M = 238.52$, $SD = 147.41$; digital: $M = 247.86$, $SD = 148.61$; mixed: $M = 252.51$, $SD = 146.16$; $F(2, 126) = 0.31$, $p = .73$, $\eta^2 = 0.01$), were statistically significant. A statistically significant interaction between reading purpose and reading medium was observed on response length, however, with $F(2, 126) = 3.17$, $p = .04$, $\eta^2 = 0.05$. Tests of the simple effects of reading purpose within each level of reading medium showed that there were statistically significant reading purpose mean differences on response length for the print medium, $F(1, 126) = 4.36$, $p = .04$, $\eta^2 = 0.03$, but not for the digital and mixed reading mediums, with $F(1, 126) = 1.82, p = .18$, $\eta^2 = 0.01$, for the digital medium, and $F(1, 126) = 1.39$, $p = .24$, $\eta^2 = 0.01$, for the mixed mediums. Thus, participants who read in preparation for an exam ($M = 265.19$, $SD = 84.68$) produced statistically significantly longer responses than participants who read for pleasure ($M = 211.85$, $SD = 84.65$) when the texts were printed. However, when the texts were digital, the response length difference between those who read for an exam ($M = 230.60$, $SD = 84.79$) and those who read for pleasure ($M = 265.13$, $SD = 85.34$) was not statistically significant. Likewise, when participants read mixed texts, the difference between those who read for an exam ($M = 267.39$, $SD = 84.70$) and those who read for pleasure ($M = 237.64$, $SD = 85.07$) was not statistically significant. Tests of the simple effects of reading medium within each level of reading purpose showed that there were no statistically significant reading medium mean differences on response length for participants who read the texts in preparation for an exam, $F(2, 126) = 1.27$, $p = .29$, $\eta^2 = 0.02$, or for participants who read the texts for pleasure, F

$(2, 126) = 2.15$, $p = .12$, $\eta^2 = 0.03$. Accordingly, paired comparisons showed that when reading in preparation for an exam, participants who read the texts in print ($M = 265.19$, $SD = 84.68$), digitally ($M = 230.60$, $SD = 84.79$), and in mixed mediums ($M = 267.39$, $SD = 84.70$) did not differ statistically significantly from each other with respect to response length ($ps > 0.17$, Cohen's $ds < 0.44$). However, when reading for pleasure, participants who read digital texts ($M = 265.13$, $SD = 85.34$) produced statistically significantly longer responses than those who read printed texts ($M = 211.85$, $SD = 84.65$; $p = .04$, Cohen's $d = 0.63$). There were no statistically significant differences between those who read digital texts and those who read mixed texts ($M = 237.64$, $SD = 85.07$; $p = .28$; Cohen's $d = 0.32$), or between those who read mixed texts and those who read printed texts ($p = .32$, Cohen's $d = 0.30$). Finally, the covariate of reading comprehension uniquely adjusted response length, with better comprehenders more likely to produce longer responses than were poorer comprehenders, with $F(1, 126) = 6.89$, $p = .01$, $\eta^2 = 0.05$. Fig. 2 shows the estimated marginal means for the length of participants' written responses for each reading medium by reading purpose.

In the ANCOVA using text integration as the dependent variable, neither the effect of reading purpose (exam: $M = 5.56$, $SD = 3.04$; pleasure: $M = 5.53$, $SD = 3.02$; $F(1, 125) = 0.01$, $p = .93$, $\eta^2 = 0.00$), nor the effect of reading medium (print: $M = 5.59$, $SD = 3.67$; digital: $M = 5.52$, $SD = 3.77$; mixed: $M = 5.52$, $SD = 3.70$; $F(2, 125) = 0.02$, $p = .99$, $\eta^2 = 0.00$), were statistically significant. There was also no statistically significant interaction between reading purpose and reading medium, with $F(2, 125) = 1.70$, $p = .19$, $\eta^2 = 0.03$. Only the covariate of reading comprehension uniquely adjusted the text integration scores, with $F(1, 125) = 23.63$, $p < .001$, $\eta^2 = 0.16$. Thus, these results indicated that better comprehenders were more likely to integrate information across the two texts than were poorer comprehenders. Fig. 3 shows the estimated marginal means for participants' text integration scores for each reading medium by reading purpose.

Finally, given the pattern of correlations showed in Table 1 and the results displayed in Fig. 2, we conducted further exploratory analyses to probe whether there was an indirect effect of reading purpose on text integration via text production (i.e., the length of the written response) when participants read printed texts. Of note is that this is possible although the c path (i.e., the effect of reading purpose on text integration) was not statistically significant (see Fig. 4), as would be
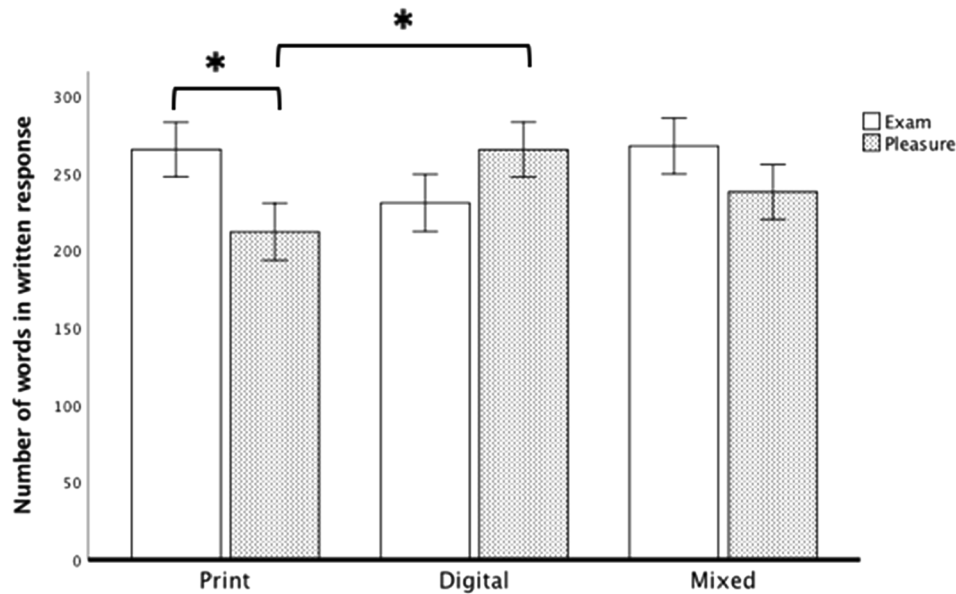
Fig. 2. Estimated marginal means for the length of the written responses for each reading medium by reading purpose. Error bars represent standard errors.

required by the conventional causal steps approach (Baron & Kenny, 1986). Although that approach to mediational analysis has been historically popular, it also has been criticized because of reduced power due to the multiple statistical significance tests that are needed to perform it (Preacher & Selig, 2012), and because it can be regarded as illogical to examine mediation without directly testing it through the *ab* path (see Fig. 4; Hayes, 2009). Therefore, we opted for the bootstrapping procedure developed by Preacher and Hayes (2008), which holds no assumption about the statistical significance of the *c* path.

Specifically, for participants in the print condition, we tested the effect of reading purpose (exam preparation vs. pleasure) on participants' text integration scores, using the length of their written responses as a mediator and scores on the cognitive reflection test and the reading comprehension measures as covariates. In this analysis, reading purpose was contrast coded (exam preparation = 1, pleasure = −1) and the other variables were centered and standardized. The indirect effect was tested using a bootstrap estimation approach with 1000 samples (Preacher & Hayes, 2008). The model accounted for a statistically significant portion of the variance, $R^2 = 0.38$, $F(4, 39) = 5.95$, $p < .001$. The bootstrapped results showed a positive statistically significant

indirect effect of reading purpose on text integration via text production, yielding an estimate of 0.12 (CI$_{95\%}$: 0.001–0.295). As can be seen in Fig. 4, the direct effect of reading purpose on text integration remained statistically non-significant, $b = -0.18$, $SE = 0.12$, $p = .16$, which is consistent with a full mediation. Finally, neither the covariate of cognitive reflection ($b = 0.17$, $SE = 0.14$, $p = .24$), nor the covariate of reading comprehension ($b = 0.18$, $SE = 0.15$, $p = .25$), was a statistically significant predictor in this analysis.

As already evident from the results displayed in Fig. 2, with no reading purpose differences on response length observed for those who read digital texts, there was no indirect effect of reading purpose on text integration via text production in the digital medium condition, suggesting that those who read printed texts were more able to adapt their engagement to the reading purpose and, as a consequence, achieve better text integration, compared to those who read digital texts.

4. Discussion

This study uniquely contributes to research on the effects of reading medium on the processes and products of reading. Thus, not only did it
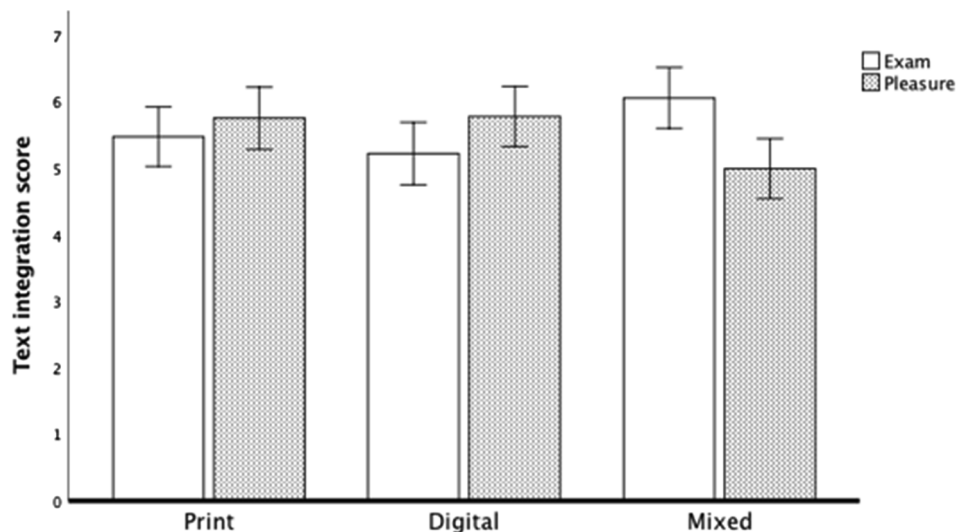

Fig. 3. Estimated marginal means for text integration for each reading medium by reading purpose. Error bars represent standard errors.
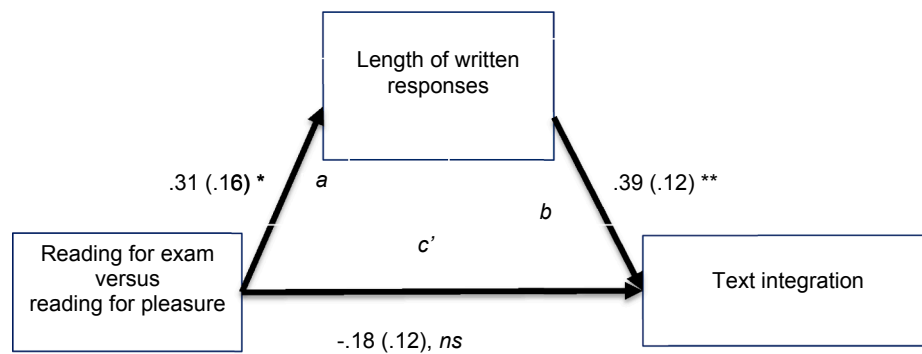
Fig. 4. Mediation model for the effect of reading purpose (contrast coded: 1 = exam preparation, −1 = pleasure) on text integration with text production (length of the written responses) as a mediator (standardized coefficients). *$p < .07$, **$p < .01$.

investigate potential effects of reading medium in the context of reading multiple complementary texts; it also addressed the possibility that effects of reading medium on reader engagement and text integration were modified by readers' purpose for working with the texts. Based on prior research on the effects of reading medium (e.g., Delgado et al., 2018) and reading purpose (e.g., van den Broek et al., 2001), as well as theoretical assumptions about the mechanisms underlying such effects (Annisette & Lafreniere, 2017; Linderholm, 2006), our expectations were straightforward: In addition to main effects of reading medium, involving that working with printed texts would lead to greater engagement in terms of time and effort and better text integration than working with digital texts, we expected that reading purpose would moderate the effects of reading medium because students reading in preparation for an exam would display greater engagement and integration regardless of reading medium. Although our findings, indeed, were less straightforward than our hypotheses, we contend that the effects that we observed may provide new insights into how reading medium and reading purpose work together in affecting behavioral engagement and text integration in multiple text contexts.

Thus, although there were no main effects of reading medium on any of our engagement measures, some interesting and interpretable interaction effects appeared. For reading time, the interaction involved that students used longer time when reading digital and mixed texts for an exam, compared to reading for pleasure, whereas there were no difference between exam and pleasure oriented reading when reading printed texts. This pattern of results may indicate that when reading in preparation for an important exam rather than for pleasure, students may invest more time in the reading of digital and mixed texts because they realize that such texts represent particular challenges in the former context, in accordance with our participants' strong preference for reading printed texts in a study context. A possible reason why students reading printed texts may invest the same amount of time regardless of reading purpose is that they also are in the habit of reading printed texts for pleasure, such as newspapers or novels, quite carefully. Of note is that these interpretations also are consistent with the findings that when reading for an exam, students used longer time when reading mixed texts than when reading printed texts, and that when reading for pleasure, students used longer time when reading printed texts than when reading digital texts. Still, we acknowledge that the interpretations we offer are tentative and somewhat speculative at this point. It is an open question, for example, to what extent undergraduates are aware of the effects of different reading mediums on their performance and, if so, are willing or able to take them into account when engaging with texts for different purposes.

For our other measure of engagement, the length of students' written responses, the most salient component of the interaction was that students produced more text when reading printed texts for an exam than when reading printed texts for pleasure, whereas there were no differences in text production between reading for an exam and reading for pleasure when reading digital or mixed texts. Interestingly, then, the results differed with respect to engagement in reading and writing, with students who read printed texts investing more effort in text production when reading in preparation for an exam than when reading for pleasure, although these students did not invest more time in reading for an exam than in reading for pleasure. One possible reason for this is that students based on previous experiences with using printed materials in preparation for exams may consider text production, in particular, to be related to exam performance. This adaption to the reading purpose for students reading printed texts also led us to explore whether there was an indirect effect of reading purpose on text integration via text production in this group of students.

Thus, while there were no main or interaction effects on text integration, an exploratory mediation analysis indicated that students who read printed texts in preparation for an exam produced longer written responses compared to those who read for pleasure and, in turn, gained a more complete understanding of the issue in question. Because this mediation effect was peculiar to the print medium condition, it suggests that the reading of printed texts may facilitate adaptability to the purpose of reading in a way that is beneficial for text integration, compared to conditions that involve digital reading.

Importantly, all effects discussed above were independent of students' basic, inferential reading comprehension skills. Of note is that this variable uniquely predicted scores on all the dependent measures and was a particularly strong predictor of students' integration of complementary information across the two texts. This highlights the need to control for this individual difference variable in future experimental investigations of potential medium effects on the processes and products of reading. Moreover, the fact that basic reading comprehension seemed to override the importance of reading medium to text integration in the current study, strongly suggests that reading comprehension is an essential target of intervention in multiple text contexts, notwithstanding the reading medium.

The interaction and mediation effects reported in this article may offer several new avenues for research on reading medium effects and potential moderators of such effects. While the shallowing hypothesis may be regarded as an important point of departure in this area of research (Annisette & Lafreniere, 2017; Delgado et al., 2018), our findings indicate that further theoretical clarification is needed. Thus,

the ways reading medium interacted with reading purpose to influence engagement and, in turn, text comprehension in this study might suggest more complex reasoning and deliberation among students than what can be captured by current conceptualizations. For example, the possibilities that students reading digital and multiple texts in preparation for an exam may compensatorily spend more time reading such texts, and that students reading printed texts may be more sensitive to reading purpose when writing from such texts than during reading, require a more complex framework capturing such contextual qualifications. Needless to say, much further experimentation is needed to test the tenability of our findings and interpretations and build this framework.

In particular, further research is needed on the role of reading medium in multiple text processing and comprehension, which is essential given the plethora of digital as well as printed sources on almost any topic that is available to learners both in and out of school (Peterson & Alexander, in press). By bringing research on reading medium and multiple text reading together for one of the very first times in the current study, we focused on the integration of information across complementary texts (Barzilai et al., 2018). One caveat concerning the measure that we used to capture text integration, however, is that it may target a form of global understanding less likely to be affected by reading medium differences (Singer & Alexander, 2017a; Singer Trakhman et al., 2018, 2019). Also when investigating potential effects of reading medium in multiple text contexts, measuring comprehension on different levels of specificity may therefore be desirable (Singer & Alexander, 2017b). Another question left open by our study concerns when text integration actually occurred. Thus, when readers of print increased their text production in the exam condition and thereby achieved better text integration, the methodology that we used does not allow us to draw any conclusions about whether integration occurred during reading, during writing, or both. For that purpose, process data such as verbal protocols or eye movements will have to be collected. Because we did not record the extent to which participants returned to previously read texts or manipulated them physically or digitally to view both texts simultaneously, including such process data in future investigations may also throw light on whether any tendencies to adopt a non-linear reading pattern might differ across reading mediums and, in turn, mediate effects of reading medium on processes and products of comprehension.

These are not the only limitations of the current research, of course. Although there was a maximum reading time based on piloting of the reading materials, readers had plenty of time and the reading was self-paced in this study, which may have influenced our results concerning reading medium effects on comprehension (or the lack of such effects; Delgado et al., 2018). Experimental manipulation of reading time is therefore desirable in future research in this area. Moreover, our participants did not read for any real purposes but were asked to imagine that they read in preparation for an exam versus for pleasure. Although this experimental manipulation has worked in prior research (Linderholm, 2006), investigating reading purpose moderation when readers read for real purposes may be an intriguing next step. Yet another limitation is that we did not measure participants' beliefs. Because the two texts, although constructed to be complementary rather than conflicting, may have represented somewhat different perspectives on the topic in question, participants' beliefs about the topic (i.e., topic beliefs) as well as their beliefs about knowledge and knowing concerning the topic (i.e., epistemic beliefs) may have come into play and influenced their processing and comprehension (Bråten & Strømsø, in press). Future investigations should therefore include such beliefs among the individual difference variables. Finally, examining this issue with other topics and other populations seems important to probe the generalizability of our findings.

Despite such limitations and all the work ahead to address them, we maintain that our study represents a nontrivial step in the direction of understanding reading medium effects in multiple text contexts. Such understanding is needed not only for theoretical but also for practical reasons. Given that both printed and digital texts likely will be used in most educational contexts for quite some time, knowledge about the similarities and differences of working with such texts for different purposes seems highly valuable for policy-makers, teachers, and students alike.

Acknowledgment

Appendix A. English versions of the two texts

Aftenposten.no
March 24th, 2018
Journalist Torunn Jebsen
Social Media – Friend or Foe?

Social media are places where you can get in touch with other people. Especially for young people, social media have become an almost indispensable part of life. Today, practically everyone uses digital devices such as smartphones, smart watches, tablets, or laptops. Therefore, social media follow us everywhere and around-the-clock. But is this only a good thing? What does being social on social media really mean? And does this mean the same for everybody? In this article, we will among other things see that the use of social media does not necessarily make us happier or wiser.

Many have expressed concerns that the increasing use of social media will actually lead to more people becoming isolated. Such a concern seems justified because it has been shown that people can feel more socially isolated the more time they spend on social media. It is a paradox that those who use social media more than two hours a day have twice as high risk of feeling lonely than those who use less than half an hour. Those who use social media relatively often respond "yes" to questions such as "I feel that people hardly know me," or "I feel people are around me, but not together with me". However, it is somewhat unclear whether those who report much use of social media feel isolated because they are often on social media, or whether they use social media because they feel isolated.

There are clear indications that the relationship with friends on social media may differ from that with friends in real life. A close and intimate friendship depends on a mutual relationship and that people are there for each other. However, the question is whether this can be expected of contacts on social media to the same extent. Loyalty and trust between people who know each other well in the real world are probably different than what occurs on social media. When Facebook users were asked to ask their contacts on Facebook to do them a favor, only ten percent of the contacts

were willing to give 10 min of their time. By comparison, most of the friends they spent time with on a daily basis offered to help, which may indicate that one's contacts on social media are not necessarily the same as close friends.

However, men and women tend to use social media differently. Many men do not primarily use social media to stay in touch with friends and family. Instead of using social media to communicate with persons who are close to them, they use them to communicate with people they do not know well or with strangers. This may involve that men use social media to discuss and comment on controversial societal and political issues. The social aspect is not the focus of such discussions, but rather the discussion itself, which is regarded as a form of public communication they figure may be rendered in other contexts. Men who primarily use social media in such a way may feel that they do not belong to any social community, even though they are very active on social media.

Not only gender differences are relevant in this connection, however.

Young people are different in regard to education and cultural preferences, which appear to be reflected in their use of social media. One example of this is the use of Twitter. Researchers have analyzed the hash-tags of a large group of Twitter users and compared these with the users' educational level. People with lower education seemed to be very occupied with celebrities and entertainment and produced little content themselves. Instead, they often liked postings from others, usually celebrities, and reposted these on their own Twitter accounts without any critical evaluation of the content. It has also been shown that Facebook users with lower education spend much time on their own profile, and on posting private photos and personal information. This may give the impression that they are relatively unconcerned about information security and personal privacy and uncritical as to what they share on social media.

Social media are here to stay. They play an increasingly greater role in a digital world. The use of social media affects both ourselves and the relationships we have with others. Perhaps social media in themselves are neither friend nor foe, but what we ourselves make of them?

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Social Media = Social People?

Humans are social beings. The group is important. Through the social we also experience ourselves. But what happens when the social meeting places are moved from the real reality to the digital reality? Because social media are now used by all groups of people, particularly by young people, it is important to understand how social media can intervene in people's lives. Does more use of social media necessarily lead to more social activity and a closer connection to the group, or can they just as easily create passivity and distance? In this article, we will see, among other things, that the use of social media is significant for how we establish and maintain relationships in digital networks.

It is undoubtedly the case that social media can contribute to expanding people's networks. This is because it is a simple and effective form of contact that practically has exploded globally with the emergence of digital technologies. Before social media became particularly prevalent, young adults usually had between 10 and 15 friends, while today they have far more contacts on social media than they have friends with whom they spend time. Social media make it easier to establish contact with many people independently of physical distance. Profiles on different social media provide information on shared interests and shared contacts, thus making it easier to acquire a wide circle of acquaintances. Through this circle of acquaintances, one can get continuous updates on different happenings and events. Such updates can give a social media user access to new acquaintances such that the network constantly grows through a kind of snowball effect.

Social media allow for insight into other people's lives in a way that was not previously possible. But on social media many people want to present themselves favorably, for example by posting photos from parties and generally portraying themselves as happy, attractive and popular. When people consciously present themselves in a positive way, social comparisons based on such a staged "reality" will be different from social comparisons one makes in real life. This is because they primarily involve an upward social comparison with people who appear socially successful. Those who follow such updates may thus be comparing themselves with unrealistic idealized images of others' lives. Because young people are in a period of life where they are especially concerned with comparing themselves to others, frequent use of social media will give them many opportunities to make such comparisons.

However, gender differences have been shown in regard to the use of social media. For women, the social is in focus and they spend much time on contact with friends and family. This may have the character of "everyday socialzing", that is using social media to keep up to date with friends, comment on their photos and postings, and post updates related to one's own everyday life. The emphasis on communication with private contacts is reflected in the way women discuss on social media. This means that when they discuss on social media, they prefer to discuss with people they know well. That is to say that women to a large degree consider discussions on social media private communication with their contacts, and not public communication that they must assume will be rendered in other contexts. Women who are not on social media may thus experience that they are not participating in an important social arena.

Young people's relationship to social media can also be influenced by social and cultural differences between the users. It may seem that people with higher education often use social media to acquire and share knowledge. For example, this may involve that they use Twitter to read and write about topics such as politics, training, and health, or that they use Facebook to share their own cultural experiences and current political and social issues. Well-educated people are also able to assess the reliability of the information they access on social media, which is a prerequisite for making well-informed choices. On the other hand, people with higher education relatively seldom post photos of themselves or their family on social media. This may be related to the fact that people with higher education are concerned about information security and personal privacy, and thus are cautious about what they share.

Social media do not appear to change people's fundamental need for a sense of belonging. People still need other people. Presumably this is part of the driving force behind the prevalence of social media. The question is whether social media can satisfy people's social needs in the same way as real life.

Appendix B. Coding system for scoring the written responses to the four integration questions

Score	Definition	Example
Question 1: *Can people's presentation of themselves in social media make a difference to the mental health of the users of social media?*		
0	Participants gave no response or described irrelevant information	Yes, especially for women
1	Participants described an aspect as represented within one of the texts	Yes, because people who spend more than 2 hour on social media may feel lonelier compared to those who use less than half an hour
2	Participants described an aspect as represented within both of the texts without integrating information about that aspect across the texts	Yes, the way it can influence mental health is that one can be influenced by looking at the success of others, see they have fun and look prettier than oneself. Some also feel lonely if they use a lot of time on social media and spend little time with real friends
3	Participants described an aspect as represented within both of the texts as well as integrating information about that aspect across the two texts	Yes, one usually presents a different picture of oneself on social media and shares big events in one's life. Others who see these selected postings can compare with their own lives. This may make one feel lonelier, for example because one perceives all others to be more social and happy
Question 2: *Is there any connection between education and the use of social media?*		
0	Participants gave no response or described irrelevant information	Yes, social media can take up much of the time of those who use them and can make them spend less time on what is more important, namely the person's education
1	Participants described an aspect as represented within one of the texts	Yes, is seems like more highly educated are concerned about information security and post fewer pictures and share less information about their private lives. This group also demonstrates that they are more critical of what they share on social media and which sources they present
2	Participants described an aspect as represented within both of the texts without integrating information about that aspect across the two texts	Those with no or lower education tend to follow celebrities and their lives on social media. They do no care much about important things but rather retweet postings from celebrities on Twitter. Those with higher education log on to social media to read the news
3	Participants described an aspect as represented within both of the texts as well as integrating information about that aspect across the two texts	The articles say that individuals with lower education often use more time on social media. People with low education post more information about themselves and follow entertainment channels on social media rather than engaging in political and societal debates. Those with higher education will, in contrast to those with low education, rather engage in societal topics on social media, and also create more content themselves
Question 3: *Can the use of social media affect friendships in any way?*		
0	Participants gave no response or described irrelevant information	Yes, one can feel that people are more often around you than with you
1	Participants described an aspect as represented within one of the texts	Yes, your friends on social media are not like the close friends you have in real life. When testing who would be there for a person, all the close friends would help out, while some of those on social media refused
2	Participants described an aspect as represented within both of the texts without integrating information about that aspect across the two texts	A survey by Facebook showed that when asked for a favor that would take 10 min, very few Facebook friends were willing to help. In contrast, when those who were asked were friends that the person spent time with daily, practically everyone wanted to help. Before social media really became popular, people usually had 10–15 friends on average. Today we see long friend lists of several hundreds, even thousands of friends on social media
3	Participants described an aspect as represented within both of the texts as well as integrating information about that aspect across the two texts	One can get a larger network and be informed about different events, which in turn may lead to new friendships or help maintain current ones, but real relationships where friends are there for each other exist only in real life
Question 4: *Is there any connection between gender and the use of social media?*		
0	Participants gave no response or described irrelevant information	Yes, it might be
1	Participants described an aspect as represented within one of the texts	Many men use social media to be able to engage in discussions about society and share on information platforms
2	Participants described an aspect as represented within both of the texts without integrating information about that aspect across the two texts	Men use social media for discussion and information. Ladies use social media for friendship, contact, and social life
3	Participants described an aspect as represented within both of the texts as well as integrating information about that aspect across the two texts	Yes, women overall use social media to keep updated about the daily life of friends, family, and colleagues. Participation in public debates is not the main focus for all of them. Men, on the other hand, are more concerned with discussing and presenting their views on topical issues. But it is important to remember that there are exceptions among both genders

Appendix C. Descriptive information (means and standard deviations) about the covariates for subgroups differing with respect to reading purpose and reading medium

	Exam preparation			Pleasure		
	Print (n = 23)	Digital (n = 21)	Mixed (n = 22)	Print (n = 21)	Digital (n = 23)	Mixed (n = 23)
Reading comprehension	27.61 (6.13)	26.19 (6.13)	27.55 (5.65)	27.43 (6.59)	25.26 (4.78)	28.57 (6.89)
Need for cognition	6.67 (1.16)	6.86 (1.13)	6.72 (1.06)	6.67 (1.16)	6.70 (0.95)	6.91 (0.99)
Perceived prior knowledge	7.91 (1.43)	7.33 (1.67)	7.56 (1.01)	7.40 (1.54)	7.94 (1.24)	7.55 (1.38)
Cognitive reflection test	1.17 (1.33)	0.90 (1.14)	1.23 (1.07)	1.17 (1.34)	0.70 (1.11)	1.11 (1.13)

Note. One-way analyses of variance using the six subgroups as the independent variable and the covariates as the dependent variables showed no statistically significant differences between the subgroups, with $F_{(5, 127)} = 0.86$, $p = .51$, $\eta^2 = 0.03$, for reading comprehension; $F_{(5, 127)} = 0.18$, $p = .97$, $\eta^2 = 0.01$, for need for cognition; $F_{(5, 127)} = 0.76$, $p = .58$, $\eta^2 = 0.03$, for perceived prior knowledge; and $F_{(5, 127)} = 0.62$, $p = .69$, $\eta^2 = 0.02$, for the cognitive reflection test.

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