



The development of adolescents' comprehension-based Internet reading activities[☆]



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ABSTRACT

Internet-based reading involves integration and evaluation of information from different sources and different formats, but also requires fluent navigation skills for adequate comprehension. The effects of linguistic (word decoding and comprehension-based print reading) and non-cognitive factors (reading frequency and self-efficacy) have extensively been studied for print reading; we know very little about their role in Internet reading, which is our focus in this study. 558 students from grades 7 to 10 performed a set of comprehension-based Internet reading tasks on a computer, while their navigation and comprehension scores were recorded. They were also assessed on print reading literacy, word decoding, Internet reading frequency and self-efficacy. Multiple regression analyses suggest that navigation skills increase proportionally with grade level and that print reading literacy and comprehension-based Internet reading share common processes. Moreover, the positive effect of navigation efficiency on Internet comprehension increases in higher grade levels. Finally, reading frequency of the Internet for informational purposes predicts Internet comprehension scores, and self-efficacy predicts more persistent and quicker navigation.

1. Introduction

The Internet has become an essential platform for reading. Reading on the Internet encompasses a wide range of activities, including different reading goals and genres (from social interaction to purposeful reading), which take place in scenarios with complex, idiosyncratic structures (from hypertext documents to lists of results). Our focus in this paper is Internet tasks in which comprehension processes are important, such as integrating information from hypertexts, searching for information in web portals or critically reading web forums.

Few conceptualizations have been proposed to more precisely define the behaviors that characterize reading hypertext documents and reading on the Internet in general (for a review see Salmerón, Strømsø, Kammerer, Stadler, & van den Broek, 2017). Most definitions agree on that navigation skills necessary to access and retrieve information are an essential competency of this construct. There is less of a consensus about to what extent two other competences, the integration of different sources of information (e.g. connecting information from different webpages) and the evaluation of information (e.g. evaluating the credibility of a recommendation in a webpage), are unique to Internet reading (for a discussion see e.g. Afflerbach & Cho, 2009). Indeed, integration and evaluation of information are central reading skills, both

in print and on the Internet. On the Internet, readers must be able to integrate information from different webpages, as well as from different formats (including those not written in a coherent manner, as is the case with printed texts). In addition, Internet readers must critically evaluate information due to the lack of editorial gatekeeping, making it so that the quality of information that can be obtained on the Internet varies a lot. Furthermore, low quality information is often provided in interfaces that appear credible (for a review see Bråten, Stadler, & Salmerón, 2016).

While we have advanced in our knowledge about what it means to be a proficient Internet reader, we still don't fully understand how students become proficient. The goal of our study is to shed light on this issue by investigating the concurrent predictors of high school students' comprehension-based Internet reading.

Recently, different authors have highlighted the need to expand our view of Internet reading by exploring the impact of non-cognitive aspects of those constructs (Naumann, 2015; Zylka, Christoph, Kroehne, Hartig, & Goldhammer, 2015). Specifically, they call for studying non-cognitive factors, such as Internet frequency of use and self-efficacy. Following these suggestions, we examined the predictive role of linguistic (word decoding, print reading comprehension) and non-cognitive factors (Internet frequency of use and self-efficacy) on the development of

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comprehension-based Internet reading. Prior to revising the literature on linguistic and non-cognitive predictors on Internet reading, we want to delimit the scenarios we have designed to assess comprehension-based Internet reading skills, inspired by the digital reading assessment developed by PISA (OECD, 2009).

1.1. Assessment of comprehension-based Internet reading

Current models of digital reading concur in that a major skillset for fluent Internet readers to master is the ability to move within and across different complex structures of Internet documents (Salmerón, Naumann, García, & Fajardo, 2017). This aspect is most obvious in hypertexts that require navigation using hyperlinks to move across pages (e.g., Wikipedia and web portals). In other scenarios, such as search engine results pages (SERPs) or web forums, although navigation may not always be necessary, readers need to know the underlying structure of the documents to be able to move within them (e.g. while in SERPs webpages are usually listed in order of thematic relevance to the user's search query, in discussion forums information is organized in reversed temporal order).

Thus, when performing a comprehension task in each of the scenarios mentioned above (e.g., comparing two posts on a forum, evaluating the credibility of information, or connecting two pieces of information) the reader needs to activate specific website knowledge structures depending on the different features of each scenario (Coiro & Dobler, 2007). Moreover, with certain formats, answering specific questions requires navigating through hyperlinks (e.g., Wikipedia or web portal scenarios), and consequently using forward inferential reasoning (Coiro & Dobler, 2007; Salmerón, Cañas, Kintsch, & Fajardo, 2005), whereas others may simply require understanding the structure of the website and scrolling through it (e.g., forums or SERPs). In sum, the assessment of comprehension-based Internet reading should include some of the scenarios discussed above, as they represent different navigation challenges that must be mastered by readers (OECD, 2009).

1.2. Language predictors of comprehension-based Internet reading

Previous works have substantially explored the relationship between print reading comprehension and comprehension-based Internet reading. As Internet texts have to be ultimately comprehended, it seems rather obvious that print reading skills are necessary to understand texts on the Internet. Indeed, there is ample evidence demonstrating that adolescents' and undergraduates' print reading comprehension facilitates comprehension in different Internet tasks, including reading to comprehend (Coiro, 2011; Naumann, Richter, Christmann, & Groeben, 2008; Salmerón & García, 2011; Sung, Wu, Chen, & Chang, 2015), and question-answering tasks (Naumann & Salmerón, 2016; Salmerón et al., 2017; Salmerón, Cerdán, & Naumann, 2015; Sung et al., 2015).

Less obvious is the relationship between print reading comprehension and navigation, which is an essential component of Internet reading, as mentioned above. Efficient navigation is usually defined as the selective selection of hyperlinks relevant to students' goals (Naumann & Salmerón, 2016). An explanation for a potential relationship between navigation and comprehension skills is that students with good reading comprehension skills may have stronger inferential reasoning skills, which allows them to make more efficient navigation decisions (Coiro & Dobler, 2007). While some studies have reported a positive relationship between print reading comprehension and efficient navigation of adolescents and undergraduates (Naumann et al., 2008; Naumann & Salmerón, 2016; Salmerón et al., 2015; Salmerón & García, 2011), others have reported a non-significant association (Leu, Kinzer, Coiro, & Cammack, 2004; Sullivan, Gnesdilow, & Puntambekar, 2011; Sullivan & Puntambekar, 2015).

The development of comprehension-based Internet reading and navigation across adolescence remains largely unexplored. In one of the few studies using samples of middle and high school students, Keil and

Kominsky (2013) used a simulated pencil and paper SERP to explore students' ability to match a search query with more or less relevant results. Students in the 6th grade reached adult level performance on tasks that could be solved by matching the word query with the words in the results' title and summary. It was only for tasks in which there was no potential word match, and therefore had to be solved by inferring the semantic relationship between query and results, that a clear development trend emerged. Students improved from 6th grade on, reaching adult performance at 10th grade. Naumann and Salmerón (2016) studied the effects of efficient navigation on performance in a question-answering task using hypertext in a sample of high school students (from 7th to 10th grade). They found that the benefits of an efficient navigation increased as a function of students' print reading comprehension skills. To explain this pattern, they proposed a threshold model: high school students may need to reach a critical level of comprehension skills before they can benefit from their navigation. Less skilled students could still be proficient in their navigation by using simple relevance cues such as word matching (Cerdán, Gilabert, & Vidal-Abarca, 2011; Salmerón et al., 2015) or links' typography (Rouet, Ros, Goumi, Macedo-Rouet, & Dinet, 2011); nevertheless they may ultimately have to make sense of the hypertext information to fulfill their assignment.

Based on this preliminary evidence, we expect that comprehension-based Internet reading and navigation will improve throughout the high school years. The positive effects of navigation on performance, however, may be more pronounced in higher grades, once students have reached a critical level of comprehension skills.

There is less known about the effect of other linguistic variables on comprehension-based Internet reading tasks. It is well-known, however, that word-related skill is an important variable in predicting print reading comprehension (Perfetti, 2007). To the best of our knowledge, only one previous study has looked at the relationship between word decoding and comprehension-based Internet reading (Fesel, Segers, & Verhoeven, 2017). The authors found that word decoding skills were a strong predictor in a hypertext study task performed by 6th grade students. Their impact in older students, and their interaction with other linguistic and non-cognitive predictors, remains unexplored.

1.3. Internet frequency of use and self-efficacy and comprehension-based Internet reading

Research on print reading has found that frequency of reading of printed fiction books predicted adolescents' print reading comprehension beyond the influence of other linguistic factors (Duncan, McGeown, Griffiths, Stothard, & Dobai, 2015). Regarding Internet reading, some studies have examined the relationship between the frequency of use of information and communication technologies (ICT) and comprehension-based Internet reading skills. Evidence suggests that this relationship is not straightforward. One could argue that frequent Internet reading is necessary for students to acquire knowledge about specific Internet website structures. However, not all Internet tasks may be challenging enough to boost the comprehension mechanisms (e.g., inference making) needed to successfully accomplish comprehension-based Internet reading tasks. Using data from the PISA 2009 assessment, Naumann (2015) found that, in 15–16 year old students, the effect of ICT frequency of use on comprehension-based Internet reading tasks varied depending on the type of use. While a high frequency of use of ICT for information tasks (e.g. 'Search the Internet for a particular topic') was related to more adaptive navigation and better performance, the opposite was found for a high frequency of use of social tasks (e.g. 'Use e-mail', 'Chat on-line') (see also Borgonovi, 2016; Lee & Wu, 2013; Pfof, Dörfler, & Artelt, 2013). Naumann (2015) suggests that, contrary to what happens in information tasks, in social interactions, students do not engage in cognitively challenging tasks (e.g., inferring the content of hyperlinks), which ultimately would improve students' comprehension skills. In the same line, Salmerón,

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