Research in Developmental Disabilities 61 (2017) 127–137

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Hypertext comprehension of deaf and hard-of-hearing students and students with specific language impairment

Helen Blom[a,*], Eliane Segers[a], Daan Hermans[a,b], Harry Knoors[a,b], Ludo Verhoeven[a,b]

[a] Behavioural Science Institute, Radboud University Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands
[b] Royal Dutch Kentalis, P.O. Box 7, 5270 BA Sint-Michielsgestel, The Netherlands

ARTICLE INFO

Article history:
Received 8 July 2016
Received in revised form
20 December 2016
Accepted 21 December 2016
Number of reviews completed is 2

ABSTRACT

This paper provides insight into the reading comprehension of hierarchically structured hypertexts within D/HH students and students with SLI. To our knowledge, it is the first study on hypertext comprehension in D/HH students and students with SLI, and it also considers the role of working memory. We compared hypertext versus linear text comprehension in D/HH students and students with SLI versus younger students without language problems who had a similar level of decoding and vocabulary. The results demonstrated no difference in text comprehension between the hierarchically structured hypertext and the linear text. Text comprehension of D/HH students and students with SLI was comparable to that of the students without language problems. In addition, there was a similar positive predictive value of visuospatial and not verbal working memory on hypertext comprehension for all three groups. The findings implicate that educational settings can make use of hierarchically structured hypertexts as well as linear texts and that children can navigate in the digital world from young age on, even if language or working memory problems are present.

1. Introduction

The expanding use of technology in the classroom stimulates digital literacy in students. As part of their academic learning process, students spend lots of time searching and reading information online. Being online, the students are confronted with hypertexts, i.e. texts containing hyperlinks. Some studies suggested that hypertext reading requires higher working memory capacity than reading a regular linear text (DeStefano & LeFevre, 2007). Only a few hypertext studies in children have been conducted, using a hierarchically structured hypertext. In general, these studies showed no lower reading comprehension of hypertexts compared to linear texts (Klois, Segers, & Verhoeven, 2013; Salmerón & García, 2012). Students with specific language impairment (henceforth called students with SLI) have lower verbal and visuospatial working memory capacity than hearing students without language problems, a pattern that is also suggested in deaf/hard-of-hearing (D/HH) students. The question then arises whether these groups have more difficulties in reading comprehension of hypertexts vs. linear texts than children without hearing and language problems. Therefore, the present study focused on hypertext

* Corresponding author at: Behavioural Science Institute, Radboud University Nijmegen, Room A.05.01, Montessorilaan 3, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands.
E-mail address: h.blom@pwo.ru.nl (H. Blom).

http://dx.doi.org/10.1016/j.ridd.2016.12.014
0891-4222/

reading comprehension versus linear text comprehension comparing D/HH students and students with SLI to a control group without hearing or language impairment. Additionally, the role of verbal and visuospatial working memory within hypertext comprehension has been studied.

1.1. Linear text comprehension in typical readers

Reading comprehension involves both reading-related skills as well as cognitive skills. Perfetti's lexical quality hypothesis suggests that both decoding skill and vocabulary level are important for reading comprehension (Perfetti, 2010). Having automatized decoding (Landi, 2010; Verhoeven, van Leeuwe, & Vermeer, 2011) and having an appropriate level of vocabulary (Braze, Tabor, Shankweiler, & Mencl, 2007) enables the reader to read and understand a text. Next to reading-related skills, cognitive components may also play a role in comprehending texts. Some research suggested that working memory is related to reading comprehension (Cain, Bryant, & Oakhill, 2004; McVay & Kane, 2012). Working memory is described as a cognitive component, that temporarily stores and processes incoming verbal and visual information (Baddeley, 1992). Drawing inferences from the text and integrating the information with what is already known requires sufficient working memory capacity (Baddeley, 2012; Just & Carpenter, 1992). Compared to good comprehenders, poor comprehenders are disadvantaged at verbal working memory measures (Wang & Gathercole, 2013).

1.2. Hypertext reading comprehension in typical readers

A hypertext is a collection of documents that contain links and nodes that are interconnected. Where linear texts are read in a linear way, by going back or forward, hypertext readers control their own reading process by deciding which navigation path to follow. It is not yet well understood how this reading process influences reading comprehension. The movement between several hyperlink connections causes an interruption in the continuous text processing and gives feelings of disorientation, therefore complicating the reading process (Lee & Tedder, 2003). On the other hand, there is research suggesting that the hypertext structure gives the opportunity to build a more detailed situation model. The Cognitive Flexibility Theory proposed that readers integrate prior knowledge with information from multiple perspectives within the hypertext to construct a new flexible situation model (Shapiro & Niederhauser, 2004). Waniek et al. (2003) compared psychology students' text content representations of linear text without a graphical overview to linear text with overview and to hypertext. There was no difference in factual knowledge between the three text types, but the quality of the text structure representation, as measured with a card-sorting task, was higher for readers of hypertext. A hypertext can thus also have beneficial effects, through the freedom to follow one's own reading path and having an external representation of the text structure.

Just like text comprehension of regular texts, both decoding and vocabulary affect hypertext comprehension in children (Fesel, Segers, & Verhoeven, accepted). However, the hypertext features may cause higher cognitive load than a linear text scheme (Niederhauser, Reynolds, Salmen, & Skolmoski, 2000) and thus place a higher emphasis on working memory than a linear text. The reader has to remember where he or she is within the text and evaluate which hyperlink to click on or not while absorbing the newly read information and add this to what he or she already knows. Readers with low working memory capacity and little prior knowledge tend to show more difficulties with reading hypertexts than linear texts (DeStefano & LeFevre, 2007). High prior knowledge readers and readers with high working memory capacity may make more use of their metacognitive skills and show no preference for either one of the text constructions. This effective use of metacognitive skills of readers with high working memory capacity in hypertexts was evidenced in the study of Naumann et al. (2008). They investigated whether verbal working memory influenced the effects of cognitive and metacognitive strategy training on learning in hypertexts. It appeared that undergraduate students with a high verbal working memory capacity had higher learning outcomes after the strategy training, while learning outcomes in students with low verbal working memory capacity became worse after strategy training. The researchers showed more effective navigation behaviors in the former than the latter group, which was related to the learning outcomes.

The role of visuospatial working memory in hypermedia learning was present in the study of Kornmann et al. (2016), who found a positive relation between spatial working memory capacity in elementary school children and learning outcomes after the exploration of a hypermedia environment. Spatial working memory was also indirectly related to learning outcomes, through effective navigational behavior within the hypermedia environment. Rouet et al. (2012) studied the effect of visuospatial working memory on recall performance specifically in hierarchically structured hypertexts. Although recognition of content was similar across students with low or high visuospatial working memory, students with low visuospatial working memory had more difficulties with recalling the information within the deeper links in the hierarchy of a hypertext. Pazzaglia et al. (2008) investigated the role of both verbal and visuospatial working memory within hypermedia use of middle school children and found both components to play a role in the processing of the information. Whereas verbal working memory helped the reader to retrieve the semantic knowledge, the visuospatial working memory was helpful in recognizing the structure of the document.

1.3. Reading comprehension in children with language problems

Language and literacy development often go hand in hand; children with language problems are more likely to show reading-related difficulties as well. Studies show that spoken language development is affected in both D/HH children