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How Reading Strategies Affect the Comprehension of Texts in Hypertext Systems

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Abstract

The use of hypertext as a relatively new technology for presenting expository texts has emerged as an alternative to traditional linear prose. One of the main points of hypertext is that it gives the reader easy access to different sources of information on a particular topic. In this context, readers faced with an expository text in hypertext have to develop a particular strategy in order to determine which information they will read and in which order they will access it. However, this possibility introduces new ways of processing information that can affect its comprehension either positively or negatively.

In this chapter we revised a series of studies exploring the strategies that readers use when reading a hypertext and how these strategies influence text comprehension. Data reveals that some aspects from navigation behaviour such as the amount of information accessed and the coherence between transited nodes affect comprehension and are modulated by individual differences on cognitive factors.

1. Introduction

Hypertext is replacing traditional linear text in important areas such as education, communication and commerce. Together with the speed and ubiquitous access to information, there is a claim that hypertext improves the learning and/or comprehension processes compared with linear text. However, the advance of hypertext has not been accompanied by research results supporting benefits of hypertext for comprehension or learning in comparison with linear text (Dillon & Gabbard, 1998; Chen & Rada, 1996). Therefore, it is important to better understand how readers comprehend information presented in hypertext format to obtain an understanding of the real benefit of using hypertext for comprehension or learning.

From the point of view of cognitive ergonomics, navigation and reading in hypertext is related to the interaction between a user (the reader) and an artefact (the hypertext). In this way, we can say that there exists a mutual dependency between human cognitive functions and the properties of the interface where the information is provided (Cañas, Salmeron, & Fajardo, 2004). From this user-centred perspective (Unz & Hesse, 1999), we should understand this interaction process, that is, how the reader interacts with the hypertext system for comprehension. Therefore, we have to know which variables, both from the system and from the reader, determine a better comprehension.

In this chapter, we review the research that has been conducted on the effect of reading strategies that readers follow on hypertext comprehension, and how variables related to reader's cognitive functions modulate it. This review would allow us to propose a framework for understanding reading comprehension in hypertext systems that could be used to find explanations for some contradictory results found in the research literature and to improve hypertext design in order to take advantage of its characteristics.

2. Cognitive Tasks Involved in Hypertext Use

Does comprehending text in hypertext format involve the same processes and abilities as those involved with linear-text comprehension? When using hypertext we have not only to read the information contained in text nodes, we also have to move between information units that compose it, following a path guided by the specific task for which we are using hypertext. There are different subtasks that conform the task of reading hypertext, which not only differ in their contents but in their cognitive requirements. Oulasvirta (2004) examines content and navigation-orienting tasks pointing out that, from the memory point of view, these tasks are dissimilar in the deepness of the processing that readers carry out, being shallower for navigation-orienting tasks.

Therefore, a good experimental strategy may be to analyse cognitive processes involved in each task separately. In this way, Kim and Hirtle (1995) classified cognitive tasks related to hypertext into three groups: informational tasks, navigation tasks and task management. Informational task is performed by the reader to comprehend the text presented in the hypertext system, while navigation and management tasks are performed to access the information units distributed among the different nodes and to coordinate accessing and reading tasks.

2.1. Comprehension or Informational Tasks

Reading and comprehending the concepts included in text nodes and the relations between them are the main informational tasks related to hypertext. From a theoretical point of view, there is a lack of specific models that cope with the special features of hypertext comprehension and learning. Therefore, researchers have worked making assumptions based on cognitive or learning models well established in linear-text research. In spite of the increase of task control falling on the reader and the cognitive constraints added by the hypertext system, it has been assumed that the basic processes involved in reading a linear text (working memory span, reading rate, word access, etc.) are the same on hypertext (Wenger & Payne, 1996), and the way of perceiving, processing and storing textual information is guided by the same principles as that in linear-text reading.

The Construction-Integration (C-I) model of text comprehension (van Dijk & Kintsch, 1983; Kintsch, 1988, 1998) has been used extensively for conducting research in the field of hypertext comprehension (Foltz, 1996; Hofman & van Oostendorp, 1999; Potelle & Rouet, 2003). The C-I model of Kinstch (1988) has shown to be very useful in explaining several topics that affect comprehension like previous knowledge of the reader (McNamara & Kintsch, 1996), the effect of advance organisers and system structure (Lorch & Lorch, 1985) or the role of text coherence (Foltz, Kintsch, & Landauer, 1998). So we can think that these topics are important in hypertext comprehension too.

The model distinguishes three levels of mental representations that a reader forms from the text: the surface level, a verbatim representation of the text; the textbase, a hierarchical propositional representation of the information within the text; and the situation model, which integrates that information with readers' prior knowledge. According to the C-I model, many factors contribute to text comprehension, but coherence and prior knowledge are the main factors.

We can say that text coherence exists when two propositions of a document share arguments and therefore are semantically related. Research results have shown that the level of coherence of a text has different results on comprehension depending on the prior knowledge of the reader. If the reader has not an adequate level of the domain's knowledge, the constructive processes needed on comprehension can be impaired or limited, especially when low-coherence texts are used. When readers with low-domain knowledge read a highly coherent text, they construct better situation models than when they read a low-coherence one. If the propositions of the two texts do not share arguments, bridging inferences must be done by accessing background knowledge in order to fill the lack of information. Regarding high knowledge readers, no differences are found when they read a low- or a high-coherent text. This is explained by assuming that for high-knowledge readers, coherence gaps allow them to make inferences, building rich elaborations and compensating the lack of explicit information with a deeper processing at situation-model level (McNamara, E. Kintsch, Songer & W. Kintsch, 1996; McNamara & Kintsch, 1996).

Additionally, hypertext coherence could be viewed from two perspectives. From a discourse production perspective, text coherence is as a property of text reflecting an author's coherence structure. In linear text, the author tries to design a coherent text with topic continuity, but this has no bearing on hypertext since the reader chooses the order and number of texts to read. From a discourse comprehension perspective, coherence can be viewed as a property of the mental representation constructed by the reader from the text read (Storrer, 2002). From this last perspective, it makes sense to ask for the importance of navigation for comprehension on hypertext environments, since the reading order of text nodes affects coherence and therefore comprehension. The studies designed to explore the role of coherence on comprehension have shown that comprehension on hypertexts is higher if they were read in a coherent manner (Foltz, 1996), and coherence between nodes transitions was responsible for differences in knowledge acquisition at situation model level (Salmeron, Cañas, Kintsch & Fajardo, 2005). This issue is of great importance from a design perspective, since hypertext designers can influence in the coherence-building process despite the fact that hypertext users select the reading order by themselves.

2.2. Hypertext Navigation and Management

The way in which the information is provided to the reader may be of great importance since in hypertext fragments are organised on text nodes that can be accessed using the navigation tools that the interface provides. Navigation on hypertext includes planning and executing routes through hypertext, deciding reading order and selecting links.

Therefore, navigation and informational tasks have to be coordinated for achieving interaction goals successfully. User and system features can influence each other since problems related to navigation can affect text comprehension. For example, Nauman, Waniek, and Krems (2001) found that the more navigational problems there are the less content can be recalled.

One of these problems is cognitive workload, which can be defined as the amount of cognitive resources that a person needs to perform a task (O'Donnell & Eggemeier, 1986). When cognitive workload is high (cognitive overhead), performance is affected. One of the causes of cognitive overhead on hypertext may be the discontinuous text-processing characteristic of hypertext reading (Storrer, 2002). Reading is only continuous within the same node, and then readers have to choose between nodes and pay attention to the navigation interface, reducing cognitive resources available for text comprehension. The additional cognitive load would mean that less-skilled readers get a lot of additional interference hindering the fulfilment of the inference (Foltz, 1996).

It seems that orientation and navigation problems occur when switching between tasks or integrating the necessary information for comprehension. In this line of research, Waniek, Brunstein, Naumann, and Krems (2003) ran an experiment aimed to examine factors relevant to orientation and navigation in hypertext, testing three kinds of electronic texts: linear text, linear text with overview, and hypertext. Their hypothesis was that a hypertext reader not only constructs a text-content representation for comprehension, but a text-structure representation for navigation. Through navigation, the reader creates a cognitive map with the relation between the different nodes linked to the mental representation of the text contents. This representation is essential for orientating and navigating through the hypertext, and for acquiring knowledge. Results of their experiments showed that orientation and navigation problems appear as a result of a clash between the two representations in some of their dimensions.

To overcome these problems associated with hypertext management and navigation, it has been proposed that system structure could be improved by using structural overviews that specify the relations between the information nodes. This can provide a guide for low-domain knowledge readers without affecting freedom of navigation, based on the hypothesis that visualization of the structure of the text could enhance their text structure's mental representation (Waniek et al., 2003). In fact, evidence exists showing that the overviews facilitate text comprehension, especially when the text is long, complex and unfamiliar (De Jong & van der Hulst, 2002; Shapiro, 2000). However, some studies show null or contradictory results (Brinkerhoff, Klein,

& Koroghlanian, 2001; Naumann, Waniek & Krems, 2001; Quathamer & Heineken, 2002; Shapiro, 1998; Waniek et al., 2003).

However, these contradictory results may only be apparent, since there are many variables that could be affecting the benefit of using overviews. In a recent revision, Shapiro and Niederhauser (2004) concluded that the effectiveness of a certain type of structure or overview hinges on interactions between learner's prior knowledge, goals and the activity level of the learner approach. Well-defined structures may be of help for achieving a good textbase and guiding low prior-knowledge readers, but ill-structured systems promote deep learning and the seeking of coherence within the system, especially for high-knowledge readers. However, the benefit of an ill-structured hypertext will disappear if the learning of reading strategy adopted by the reader is passive.

3. The Effect of Reading Strategies on Reading Comprehension in Hypertext Systems

It seems that the reading strategies that readers follow to select the reading order can affect comprehension indirectly by leading the reader to process a particular text in a particular way. To be precise, reading strategies could determine the amount of information a reader accesses, and the reading order of the different sections. Therefore, a reader's navigation behaviour could be considered as one of the main factors affecting comprehension outcomes. When readers are confronted with a hypertext, they have not only to decide what sections or nodes to access but also have to choose in which order they are going to do so. In this way, using a hypertext has much to do with problem solving (Foltz, 1996), and these reading strategies in hypertext can be considered the decision rule that a reader follows to navigate through the different nodes of a hypertext. But what is the exact effect of these navigation or reading strategies on comprehension?

First, we have to note that there are some methodological issues affecting the answer of this question. As we have seen in the later section, the disagreement about the joint effects of reading strategies and system and user features on hypertext comprehension could be explained by the fact that experimental variables tend to interact in the complex hypertext environment, leading to confounding results (Shapiro & Niederhauser, 2004). For that reason, there are some proposals for clarifying the state of the art in the field by including pre-testing of prior knowledge (Dillon & Gabbard, 1998), using several measures of text comprehension (Hofman & van Oostendorp, 1999) and deepening the understanding of the interdependence between navigation behaviour and the learning performance (Unz & Hesse, 1999).

In relation to the last proposal, Salmeron et al. (2005) have conducted a set of experiments in order to examine the differential effect of reading strategies on comprehension outcomes. The results of the experiments showed the importance of controlling reading strategies in order to avoid the confounding of their effects with those related to text characteristics that could be predicted by text-comprehension models.

In the first experiment, they found that an increase in the amount of information read in a hypertext facilitates the construction of the textbase, whereas the reading order through sections was associated with differences in the construction of the situation model. In the experiment, participants had to read an expository text on atmosphere pollution adapted to hypertext that consisted of 24 nodes, which can be accessed through a hierarchical overview. Coherence between nodes was analysed using latent semantic analysis (LSA) (Foltz et al., 1998). Before the reading phase, readers were pre-tested for knowledge on atmospheric pollution. The post-test of atmospheric-pollution knowledge was conducted with text-based questions for measuring knowledge acquisition at textbase level, and cued association task and inference questions for measuring knowledge acquisition at situation model level.

The analysis of reading strategies was done by focusing on the navigational path of the reader, using multidimensional scaling techniques for identifying similar groups of navigational paths and analysing differences between groups. In this way, participants were assigned to one of the three reading order groups after examining node-transition matrixes: the first grouped subjects that followed a linear order, the second, grouped those that followed overview in a top-down order and the third grouped those that followed a combination of the other orders or a different order. Results showed that knowledge acquisition at textbase level was predicted by the amount of information read (different nodes accessed). This was only true for low-knowledge readers but not for high-knowledge readers. The amount of nodes accessed had no effect at situation-model level. On the contrary, reading order had a main effect on cued association and inference questions scores, but not on text-based questions scores. In order to explain the differences between readers' orders, the three different groups were compared on different dependent measures. Reading order groups did not differ on previous knowledge, but it did on the nodes accessed and on coherence between transitions. It seems that a minimum number of nodes must be read in order to construct an appropriate situation model, but when a similar number of nodes are read, differences on the learning outcomes were due to differences with the reading order.

In a second experiment, Salmeron et al. (2005) tried to replicate the effect of knowledge and coherence (McNamara et al., 1996; McNamara & Kintsch, 1996) on hypertext. Their hypothesis was that low-knowledge readers benefit more from a high-coherent text then from an incoherent one, and on the contrary, high-knowledge readers learn more from a low coherent text. In this experiment, subjects read all the nodes with the aid of one of the two overviews (high- and low-coherence). Additionally, the coherence of the reading order (high and low-coherence) was measured. Results showed that the effect of knowledge and coherence was replicated on hypertext only if the reading order was taken into account.

So, people using different reading strategies follow a different reading order and, as a consequence of that, focus on different aspects of the text, and that could affect the comprehension of the relations between the different sections of a text. Although this was a well known relation reported in the literature of linear text (Magliano, Trabasso, & Graesser, 1999; McNamara, 2004; McNamara & Scott, 1999; Trabasso & Magliano, 1996), we need to better understand the type of strategies that hypertext readers follow when their main purpose is to comprehend a text in hypertext format (Unz & Hesse, 1999).

One possible reading strategy is maintaining coherence. In an experiment conducted by Foltz (1996), subjects were instructed to read the texts that compound a hypertext in silence but describing what they were thinking when making any node transition. Analysis of verbal protocols showed that subjects used strategies for maintaining the global coherence of the text, and it seemed that they relied on the map and node titles for guiding their decisions. But, this could not be the only possible strategy since reading strategies can go further on hypertext than in linear text and could depend on hypertext navigation tools and on the goals of the readers.

Some studies differentiate between reading strategies by describing the criteria followed by participants for the selection of the reading order. For example, Lawless and Kulikowich (1998) suggested three kinds of hypertext user: knowledge seekers, feature explorers and apathetic hypertext users. Other descriptions of possible reading strategies on hypertext were provided by Balcytiene (1999), who conducted a study examining processes of knowledge construction with hypertext. In this study, subjects using a hypertext for learning on “Gothic style” were filmed during navigation and interviewed after the task was completed. Three main reading patterns were identified: systematic reading, exploration due to individual preferences (interest) and systematic versus explorative reading. It was found that the two former patterns were more successful than the latter for learning.

In a set of experiments, Salmeron, Kintsch & Cañas (2006) have followed an approach aimed to identify the main reading strategies followed by hypertext readers and their interactive effect with previous knowledge. They first identified three reading strategies on hypertext readers: coherence strategy, interest strategy and easiness strategy. Coherence strategy (Foltz, 1996) consisted of selecting the reading order in order to maintain global coherence, choosing the link most related to the text just read. When following an interest strategy, readers first choose the links that they considered most interesting. Finally, the easiness strategy was followed by readers who first selected the links they considered easiest.

In the first experiment, they used a hypertext about atmosphere pollution with 27 nodes. After reading each node, participants have to freely choose between two nodes: the one with the lowest coherence with the previous text and the one with the highest coherence. They answered a pre-test about the topic, and after reading all the contents of the hypertext they had to answer a text-based questionnaire and inference questions, and to perform a judgement related task for measuring knowledge acquisition. Finally, participants were asked about the criteria used for selecting the links. Participants were grouped according to the following criteria: coherence, interest and linear strategy groups. They were divided into low- and intermediate-knowledge groups according to their pre-test score.

The results showed that low-knowledge readers following the coherence strategy scored higher in the two situation-model measures (judgement-related task and inference questions) than those of the interest strategy, and the same pattern was observed when compared with a linear selection of contents. This was not true for high-knowledge readers. There was only an effect of previous knowledge on textbase knowledge but no effect of strategy was found, supporting previous research that showed that textbase was affected by the number of nodes accessed (Salmeron et al., 2005) but not by the reading order of the text nodes (Naumann, Waniek, Brunstein, & Krems, 2003; Salmeron et al., 2005).

So, for low-knowledge readers, coherence strategy seemed to be the best, but for high knowledge readers there were no differences between strategies. These results for participants with prior knowledge can be explained by the use of strategic processing. It is assumed that when reading a hypertext, there are both a strategic influence derived from the use of a particular reading strategy and a text-induced influence related to text coherence changes due to the reading order (Salmeron et al., 2005). In order to select a coherent link, readers have to process the semantic relation between the previous text and the links presented, and consequently to engage in an active processing of the text that allows high-knowledge readers to overcome the shallow processing than can be induced otherwise by a high-coherent order.

In a second experiment, participants in one group were instructed to follow a particular strategy (coherence or interest) and their performance was compared with that of two control groups in which participants read the texts linearly in either a low- or high-coherence order. Results of this experiment supported the results of Experiment 1: low-knowledge readers using a coherence strategy performed better than readers using an interest strategy both in the related judgment task and in inference questions. This effect was not found with intermediate knowledge readers. Analysis of text-based questions showed no differences between groups. Interestingly, the analysis of the control groups showed that low readers learnt more from a high-coherent reading order, whereas intermediate knowledge readers learnt more with a low-coherent reading order. No differences were found for text-based questions.

The most interesting result of Experiment 2 was obtained when comparing the strategy groups with the control ones. The authors hypothesised that the differences between a strategy group and its control group could be interpreted, assuming that the comprehension effect of a particular strategy is not only text-induced by reading order, but also independent of it. The results showed no differences between strategies and control groups for low-knowledge readers, and between interest strategy and their control group for intermediate knowledge readers. Even though, intermediate participants following the coherence strategy learnt more than those reading a high-coherence order without link selection linearly.

Therefore, the conclusions of this study was that the effect of the type of reading strategy for low-knowledge readers on comprehension seems to be produced indirectly by the coherence of the reading order selected. Otherwise, there is a strategic processing effect for prior-knowledge readers using the coherence strategy that forces them to engage in active processing compared with those that read the high-coherence text without selecting the order. No strategic effect was found for intermediate-knowledge readers following an interest strategy, but authors were careful to make strong conclusions about that, due to the difficulty of creating optimal conditions in which readers follow an interest strategy and at the same time follow a high-coherent reading order.

Therefore, strategic processing effects seem to be responsible for the benefit observed in advanced learners in several studies comparing hypertext and linear text. Similar conclusions can be extracted from the Cognitive Flexibility Theory (CFT) (Spiro, Coulson, Feltovich, & Anderson, 1988). From the CFT point of view, prior knowledge has to be first deconstructed and then reconstructed, and this implies flexibility to apply this knowledge to every new case or situation. Predictions of this theory have some implications for hypertext comprehension and learning (for a revision, see Shapiro & Niederhauser, 2004). Concretely, hypertext offers the possibility of accessing the same document from several perspectives, so one text can be accessed repeatedly from multiple different nodes, and this can enhance the ability of the reader to use his knowledge in a more flexible way.

In summation, the evidence in this section pointed to a joint effect of prior knowledge, reading strategies and navigation pattern for explaining differences on comprehension outcomes with hypertext. Different reading strategies may lead to different navigational patterns, varying the global coherence and amount of text read and then affecting knowledge acquisition. Additionally, the effect of reading strategies on hypertext seems to be different, depending on the level of prior knowledge of the reader.

However, a further step in explaining hypertext comprehension processes would be to find out why readers follow a particular strategy and no other. In the next section we examine user and system characteristics that are related to readers' navigational and reading strategies in order to explore this issue.

4. What Determines Reading and Navigational Strategies?

As we have already seen, navigating hypertext for comprehension is similar to problem solving. The information contained in the hypertext has to be extracted in a meaningful way, and this depends mainly on two groups of factors: the conjunction of reader knowledge, abilities and skills, and the way in which the system is structured and the navigation tools that it provides, which could enhance or hinder the comprehension process. All these factors affect both the adoption of a particular reading strategy on hypertext, before reading starts, and then its necessary updating during the reading process. For example, readers can adopt a coherence strategy for reading a hypertext, but an ill-structured system structure can abort this strategy if readers are low-knowledge and cues for searching coherence are not explicit. So, reading and navigational strategies can be modulated, modified, enhanced or impaired by system features and/or cognitive requirements of the task.

There is a broad range of readers' characteristics that could affect their reading strategies, including prior domain knowledge, reading abilities, personality traits, cognitive styles and cognitive factors (working memory span, spatial abilities, perceptual speed, etc.). The specific learning or cognitive style of the reader has been proposed to be an important factor in determining the adoption of a particular reading strategy on hypertext. Hypertext readers could adopt navigational behaviours consistent with their cognitive styles.

For example, Chen and McRedie (2002) have made a distinction between field-dependent and field-independent readers. In a series of experiments conducted by these authors, the results showed that field-independent readers take an active approach, exploring their own navigation patterns, whereas field-dependent readers get lost easily and bring their attention to the more salient signals regardless of their relevance. This is the reason why field dependent readers follow the overview provided by the system passively. In a similar approach, Balcytiene (1999) differentiated between self-regulated and cue-dependent learners. Self-regulated learners tend to extract information in a systematic way, starting first with the construction of the mental model for guiding the learning process from a problem-solving framework. In contrast, cue-dependent readers are not consistent in their reading behaviour and need to be guided in their learning process. Other differences in reading behaviour on hypertext have been found in the literature between verbalise and image-cognitive style (Graff, 2005), analytical-sequential and holistic-intuitive (Calcaterra, Antonietti, & Underwood, 2005) or between holist and serialists cognitive styles (Ford & Chen, 2000).

With regard to cognitive factors that could affect the adoption of a particular reading strategy, we can see that from the beginning, research on hypertext has been led by the idea that hypertext may reflect the basic principles of the functioning of human mind (Bush, 1945; Jonassen, 1990; Delany & Gilbert, 1991). Therefore, researchers have worked with the premise that hypertext navigation is intuitive "*per se*", since using associative retrieval paths (links) is similar to the way retrieval is performed in memory (Foltz, 1996). Although this might be true, references to orientation and navigational problems on the hypertext literature have been found frequently (Boechler, 2001; Diaz & Souza, 1997; McDonald & Stevenson, 1996; Ransom, Wu, & Schmidt, 1997). Those problems could be explained by the excessive cognitive requirements created by the interaction with the hypertext system.

For example, Juvina and van Oostendorp (2004) performed an experiment aimed to determine cognitive predictors of user navigation. Results showed that cognitive factors, like spatial ability, working memory and episodic memory were related to some aspects of navigational behaviour. Specifically, low-working memory capacity was a predictor of orientation problems meanwhile spatial ability predicts task performance. Some other studies have also shown the important implication of spatial cognition on hypertext navigation. For example, Dahlbäck, Höök, and Sjölinder (1996) have found a strong correlation between the performance on image rotation tests and navigation task timing. These results are consistent with the data of a meta-analysis performed by Chen and Rada (1996) that showed a consistent effect of spatial abilities on hypertext efficiency measures. If we define spatial cognition as an ability that comprises the knowledge and the mental representation of spatial structure (Liben, 1981), we can say that the spatial cognitive component of navigation implies the knowledge and mental representation of the hypertext structure, together with knowledge about how to use this information for task performance, and the capacity of thinking in hypertext mental representation.

Obviously, working memory has an important role in managing hypertext tasks. As in linear text, the contents of a working memory required for text comprehension include sensorial aspects, linguistic expressions, propositional structures, situational models, goals, lexical knowledge and schemas, which are necessary for making inferences (van Dijk & Kintsch, 1983; Kintsch, Patel, & Ericsson, 1999). However, working memory requirements are greater in hypertext than in linear text (Conklin, 1987; Tardieu & Gyselinck, 2002), and the balance of cognitive resources is different, with more importance placed on relational and spatial process than on hypertext (Wenger & Payne, 1996). Naumann et al., (2003) have found that in hypertext reading high-working memory load would lead to more navigation problems and less-acquired knowledge, since navigation in hypertext consumes working memory resources and working memory capacity is limited. Furthermore, when hypertext is attached with graphics, images and other media (hypermedia, multimedia) the cognitive requirements of the task increase. For example, Tardieu and Gyselink (2002) have shown that when using multimedia material, users get new constraints related to working memory on integrating and comprehending information.

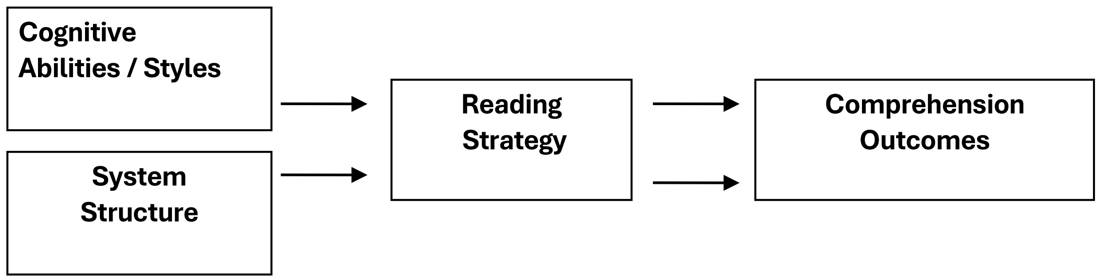
However, these studies failed to address the interactive effect of cognitive factors and the navigation pattern (strategy) followed by the reader. Only recently, Madrid, Salmeron, Cañas, and Fajardo (2005) have examined the role of nine cognitive factors on the navigational pattern of the reader. The hypothesis of their experiment was that cognitive factors associated with navigational variables can modulate hypertext comprehension. They found that spatial abilities are related to the amount of information read (nodes accessed) and that the level in which readers follow the structural overview provided for navigation was affected by their working memory capacity. The results were in agreement with a limited capacity view in which a task that exceeds our cognitive resources has a negative impact on our performance. Therefore, cognitive requirement increases in hypertext when readers have to switch between informational and navigation tasks for acquiring knowledge.

We might conclude that there are some user and system features that influence hypertext use and comprehension. Navigating behaviour and individual differences in prior knowledge and cognitive factors/styles/abilities seem to play an important role in knowledge acquisition on hypertext. However, more research is needed to explore how these cognitive factors determine the adoption of a particular reading strategy.

5. Conclusion

This chapter tries to bring attention to several system and reader features that can affect hypertext comprehension and learning. It was shown consistently that the reading strategies of the reader affect comprehension indirectly by means of their navigation pattern, and directly by the adoption of an active processing approach. As Salmeron et al. (2006) showed, the selection of the reading strategy can be very important especially for low knowledge readers, because reading strategies that make the readers follow an incoherent pattern brings poor comprehension outcomes.

The adoption of a particular reading strategy depends on several aspects both concerning the reader and the system structure. However, the complexity of having many factors involved in hypertext comprehension may lead to confusing results and erroneous conclusions, so we propose that the relation between user and system features, navigating behaviour and comprehension outcomes must be analysed carefully. The research results reviewed in this chapter show that it is not possible to make cognitive predictions about hypertext comprehension if we do not take into account the individual differences and navigational pattern of the hypertext readers. Therefore, we could propose a general framework for conducting research on hypertext comprehension and for understanding the user and system factors that affect it, such as the one represented in Figure 14.1. In this framework, the two basic ideas are as follows: (1) any variable that is thought to be affecting reading comprehension must be examined in relation to the particular reading strategy that the reader adopts; and (2) that strategy must be explained by the interaction of reader cognitive characteristics and the hypertext system design features.



As this framework shows, results obtained on experiment testing the influence of cognitive abilities and system structure on comprehension outcomes may be overshadowed by the effect of reading strategy.

This schema has clear implications for the design and use of hypertext documents in the workplace. Enhancing the use of technical documents on hypertext requires that system structure fits different reading strategies and cognitive abilities for better comprehension outcomes. In this way, adaptive hypermedia systems have been suggested to overcome problems related to individual differences (Brusilovsky, 2001).

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