

Reading theories and some implications for the processing of linear texts and hypertexts

(Teorias sobre a leitura e suas implicações para o processamento de textos lineares e hipertextos)

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ABSTRACT: According to some reading theories, linearity, textual cohesion as well as textual organization are crucial for processing (Kintsch 1998; Smith, 1994; Charney 1994; Halliday & Hasan, 1976, among others). What happens, then, when readers have to deal with texts which break with these patterns, such as hypertexts? May processing be hindered and comprehension compromised? The purpose of this work is to provide a brief overview on reading theories focusing, and reflecting on researchers' divergent claims related to the processing of linear texts and hypertext.

RESUMO: De acordo com algumas teorias sobre a leitura, a linearidade, a coesão textual bem como a organização textual são aspectos cruciais para o processamento da mensagem (Kintsch, 1998; Smith; 1994; Charney, 1994; Halliday & Hasan, 1976, entre outros). O que ocorre,

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então, quando os leitores se deparam com textos que não seguem tais padrões organizacionais, tais como os hipertextos? Podem estes textos gerar mais rupturas no processamento dificultando a compreensão? O propósito deste ensaio é apresentar uma breve análise em teorias sobre a leitura que envolvem o processamento de textos lineares e hipertextos, enfocando e refletindo sobre os pontos divergentes de seus pesquisadores.

KEY-WORDS: *Linear texts, hypertexts, textual organization, cognition, processing.*

PALAVRAS CHAVE: *Textos lineares, hipertextos, organização textual, cognição, processamento.*

INTRODUCTION

Computers have revolutionized the way information is conveyed. Illustrating, Dee-Lucas (1996) explains that while a traditional text uses rhetorical organization indicating the structuring of ideas, a hypertext does not follow the same principle because the organization of the information may be presented external to the contents of the text. While the former characteristic may facilitate text processing, the second may hinder it.

Another perspective is given by Rouet, Levonen, Dillon and Spiro (1996) who describe hypertexts as networks of information in which "nodes are text chunks and links are relationships between the nodes" (p.03). And, in order to process information meaningfully readers have to select the appropriate nodes, and link them in the already embedded representations within their minds.

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Therefore, while traditional texts seem to follow a “linear bounded and fixed nature”, hypertexts are nonlinear, multidimensional information systems which can be structured through a “cross-referenced body of information in a number of different forms (texts, graphics, audio, video among others” (Mishra, Spiro & Feltovich, 1996, p.290), for different purposes.

Processing hypertexts requires the integration of characteristics which are inherent to the reader’s nature (e.g. cognitive abilities, strategies and expertise in the domain), as well as to aspects provided by the machine, such as navigation tools, information structures, accessibility for location of text windows among others. All these factors may influence, and directly affect, reading processing, and thus, comprehension. How, then, do readers process new information? What do theories have to say about the processing of linear texts and hypertexts?

The aim of this study is to present some of the theories which underlie and try to explain reading processing, focusing on text characteristics as well as on readers' cognitive aspects. In the first part I will be referring to how some cognitive theories try to explain the processing of new information. After that, I will be discussing about different perspectives on linear texts and hypertexts processing. Finally, the focus will be on strategies and skills and their role on comprehension.

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THEORETICAL BACKGROUND

Theories on comprehension and discourse processing

How do we process information? What importance do textual organizations have in the processing of input? In this section I am going to present some studies related to the cognitive aspects of processing; that is, how theories try to explain the transformation of external stimuli, (written language in this specific case), sometimes chaotic, into coherent meaningful mental representations.

People produce information, and process it as a mechanical activity, without the awareness of the complex cognitive processes and mechanisms underlying it. Thus, in order to make the world around us meaningful, for example, we have to build a “mental” home for every new input captured. The same occurs with reading, that is, in order to achieve comprehension readers have to *reconstruct* and *reorganize* a text mentally, linking new information to that already stored in memory, forming new coherent mental pictures (Kintsch & van Dijk, 1978). However, processing can be constrained by different factors such as readers' individual cognitive characteristics (skills, strategies and schemata), as well as by some text properties.

Thus, considering text characteristics, we could say that a good local organization, that is, texts with devices clearly signaling the relation between words, sentences and paragraphs, for example, can facilitate processing by eliciting structural paths which readers should take for bridging and organizing the ideas, within the text and mentally. And, the faster the linking between text elements, and memory representations, the less probability for a

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break down in the process, and thus, in comprehension. Hence, researchers have tried to investigate, and explain which factors may be involved in reading comprehension, and how they interrelate helping or affecting processing (Gernsbacher, 1990; Kintsch, 1998; Kintsch, 1983; Perfetti, 1985; van Dijk & Kintsch, 1983, just to name some)

Attempting to describe how cognitive processes may work in the construction of comprehension, Gernsbacher (1990) developed what he has called the "Structure Building Framework". According to this theory, to comprehend texts readers have, firstly, to lay foundations for the new input (words, sentences etc). At this stage, processing may be slower because it represents the initial phase in the construction and organization of mental structures requiring, generally, more time for integration. After the foundation has been established, the incoming information is mapped onto pre-existing memory nodes, forming new structures. And, the more overlap between new input and the previous stored knowledge, the stronger the connections, thus, the easier the retrieval of concepts, and comprehension. However, if the incoming input does not fit or cohere with any stored nodes, there is a shift in the mechanism, which starts the mapping process again.

Two cognitive mechanisms control memory information processing. Suppression, when the information is irrelevant and no longer necessary for comprehension, and enhancement when it is still necessary for processing, and for building new structures (Gernsbacher, 1990). According to O'Brien (1995), the mapping process will establish both local and global coherence.

Local coherence connects the information being processed to the immediate context, while global coherence connects "currently processed information with the

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one already stored in active memory" (O'Brien, 1995, p.160). Thus, what seems to be a simple mechanical process after being mastered, reading is, in fact, a complex memory operation.

Local coherence may be elicited by, for example, "argument overlap, causal inferences, meaning relations among sentences" (Murray, 1995, p.107), or it can be signaled by cohesive elements such as conjunctions, references, and ellipsis. These elements play different roles at the text base level and, in some way, indicate the connections, within the textual features, that readers should notice in order to facilitate words, sentences, and paragraph integrations. Such linking may speed up reading, mainly in long texts, lessening the need for the production of inferences, which are working memory resource consuming (Keenan & Kintsch, 1974).

Cohesive features, however, may have effect only at the superficial level of the discourse and their efficacy may be partial and specific, that is, varying from reader to reader according to his/her skills, language proficiency and knowledge of the world (Urquhart & Weir, 1998). Different views can be found in the literature relating the benefits of using connectives. Thus, at the same time that some researchers emphasize the importance of connectives for facilitating coherence (Sinatra & Loxterman, 1991; Lorch, 1977; Halliday & Hasan 1976; Britton, Glynn, Meyer & Penland, 1982), others place less importance on them (van Dijk, 1977; Loman & Meyer, 1983 among others). Therefore, the integrative benefits connectors may have still need more research to be conclusive.

Foltz (1996) gives another perspective for text comprehension claiming that processing occurs at many levels, ranging from the basic recognition of single words

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to high-level inferences generation. And, for investigating both local and global level of discourse, that is, the text base and the situation model, a well known model is the one proposed by Kintsch and van Dijk (1983). According to these researchers the basic units of analysis are called "propositions"; considered to be the "semantic processing units of the mind" (Kintsch, 1998, p.69).

Kintsch and van Dijk (1983) explain that propositions are linked together in texts through semantic coherence relations. The result of such organization is a hierarchically organized textual structure, which facilitates processing. Propositions result from verbs, adjectives, adverbs, sentence connectives and are mostly traceable elements, that is, they elicit important information readers should link to achieve the author's intended meanings. They can be distinguished as: "micropropositions" and "macropropositions".

Micropropositions are units used to organize the writers' ideas. They form the text base or local level of the discourse, also known as microstructure. The microstructure is important because by the overlapping of ideas it shows the relations between the propositions facilitating mapping, the construction of coherence, and therefore, comprehension.

When readers organize, and hierarchically relate the propositions available in the microstructure, they form the macrostructure, or the "global organization of a text" (Kintsch, 1998, p.66). The interplay of text base elements, and characteristics such as "general cultural knowledge, situation type, the participants categories, type of interaction, conventions and habit" (Kintsch, 1998, p.67) work together in the formation of the macrostructures. Thus, while microstructures enable analysis at the local level of

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the discourse, macrostructures allow us to investigate the discourse as a whole. And, since macrostructures represent the main idea of texts, they are also important for investigating readers' comprehension and recall, eliciting how readers may process specific texts.

In order to produce a coherent semantic relationship within micro and macro elements, readers have to mentally "map" important from irrelevant information within the text. Such search is done by the "macrorules" (van Dijk, 1980). These rules have three different aspects: selection, generalization and construction. Selection sorts relevant from irrelevant propositions, deleting the ones which cannot be bridged. Generalization represents the deletion of redundant information. Finally, construction provides a "superordinate" term for members of a category, such as animals for cats (Brown & Days, 1983). These processes should occur automatically to avoid a break down in processing.

When investigating micro and macro structures of texts we are not only trying to understand discourse comprehension from the perspective of their local level textual structures, we are also trying to scrutinize aspects related to readers cognition; how processing occurs from "behind the eyes".

At this point it may be clear that text processing may be affected by text characteristics, contexts, as well as readers' particularities. At first sight, comparing reading linear texts with hypertexts, one is tempted to claim that it is easier to process linear texts because readers are more familiar with their organization and structures, which could facilitate, among other aspects, the integration between sentences and paragraphs. However, what do

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reading theories have to say about the processing of these two types of texts?

Reading theories and the processing of linear texts and hypertexts

There is no consensus in the literature when the subject is linear text and hypertext studies. Thus, at the same time that we have a researcher claiming that hypertexts “change fundamentally how we write, how we read, how we teach these skills, and even how we conceive of texts (Charney, 1998, p.239)”, we can also find views advocating that “hypertext is not a new form of text. It is not an evolutionary advance. It forces no reconsideration. It has no potential for fundamental change in how we write or read (Dobrin, 1998, p.308)”. Why do we find such antagonist views about the same subject? One possible answer could be that, since many variables may affect and influence the way readers process linear texts and hypertexts, different results and interpretations are not unexpected. Besides, we have to bear in mind the fact that there is no axiomatic statement when referring to cognitive processes.

Moulthrop and Kaplan (1994) understand hypertexts as different forms of written texts. However, they explain that despite all the “dynamism” we may notice in a hypertext, the interface between reader and text continues “internal and passive” (Iser, 1978, as cited in Moulthrop & Kaplan, 1994, p.221) proposes. Nevertheless, these researchers explain that such readers’ passiveness is not observed in hypertexts called “constructive”; an open work where the distinctions between “reception and production” have no boundaries. Constructive hypertexts, differently from the “exploratory” ones, which basically demand me-

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chanical procedures, requires readers to have a “capability to act: to create, to change and to recover particular encounters within the developing of knowledge” (Joyce, 1989, as cited in Moulthrop & Kaplan, 1994, p.221). Constructive hypertext, then, would represent new ways of reading, and writing texts. Despite the difference in readers’ approach to a text, that is, passively or actively, according to Moulthrop and Kaplan (1994), hypertexts transactions are always a “physical event”.

I believe Moulthrop and Kaplan’s standpoints may require some considerations. First, since linear texts may also be considered a “physical event”, in what sense are they applying such concept? Second, what they consider *passive* “purely mental events”: decoding, matching, predicting, passive *syntheses*, (my stress), as they state, may be questionable paradigms depending on the cognitive demand of the task such activities are applied.

Also attempting to establish possible differences between the reading of hypertext and linear texts, Britt, Rouet and Perfetti (1996) presented the results of two studies performed by Gordon, Gustavel, Moore, & Hankey (1988), and Dee-Lucas and Larkin’s (1992), explaining that when comparing the same materials, used in hypertext and linear text versions, these researchers found differences in their results. Thus, for Gordon et al., linearity resulted in better comprehension and recall of main ideas, when compared to the organization of hypertexts. On the other hand, Dee-Lucas and Larkin (1992), found that *hierarchical hypertext* may represent advantages over linear texts, both in recall and memory.

However, it is important to emphasize that hypertexts, generally, do not present ideas in conceptual hierarchy, rather, ideas are constructed as chunks of nodes which

have to be properly selected and connected by the readers, for enabling the construction of coherent mental representations. Experts in reading hypertext may have no problem in choosing the right links to perform the activity satisfactorily, nevertheless, novices, with little familiarity with the process, might choose wrong nodes for integration, disrupting the flux of processing and thus, comprehension. However, according to Dee-Lucas and Larking (1992), this aspect would not represent a problem because, in their research, they concluded that reading instruction could help readers to overcome many of the problems encountered while reading hypertexts.

However, explaining that hypertexts are “nonlinear” only because they can be read in different sequential orders would be a naïve conception taking into consideration that linear texts can also be accessed in many forms, as for example, following indexes and tables of contents.

Attempting to establish which points are important in defining what “linear/nonlinear” texts comprise, Espéret (1996), explains that there are three aspects to take into consideration: “the organization of lower level language units, the way information is stored in a given medium (book, tape, hypertext, etc); and the way the reader controls the process of accessing a piece of information” (p.150).

Lower level order, in any language, to be meaningful and comprehensible has to be organized in a linear form. That is, writers have to organize and encode their thoughts in a coherent syntactic way so that readers can achieve semantic and pragmatic meanings more effectively. Thus, at the lower level, both traditional texts and hypertexts should present the same clear structural basis signaling the connections within nodes, since such organi-

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zations facilitate reading and learning (Charney, 1994). However, at the same time that both types of text use cohesive devices and common referents to facilitate the integration of sentences and paragraphs, they are less used in hypertexts (Goldman, 1996). The reason for the low frequency of such features is that writers, in hypertexts, do not know which paths readers will take for integrating ideas and concepts. Therefore, phrases which could signal semantic relationships, such as “in addition, however, first, and so on”, can be useless for guiding readers in linking chunks of texts when they read nonlinearly.

Therefore, in linear texts writers organize the propositions in a hierarchical order signaling, by rhetorical indicators, the importance of the nodes within the text content. On the other hand, the organization of hypertexts is provided “external to the units of the text proper” (Dee-Lucas, 1994, p.74). Besides, while in linear texts it is the reader who chooses the paths to read, in hypertexts it is the writer who establishes the relevance of connections readers should make to integrate information. Thus, hypertext writers have to strategically design or create access facilities, which indicate and determine how readers are supposed to understand and follow text contents. Therefore, a well-elaborated access facility may be crucial for the selection and integration of information (Dee-Lucas, 1994), because when readers do not detect such relevance he/she may get lost. Thus, at the same time that a hypertext may give more flexibility and freedom to the readers, who may quickly access only the main parts of a document, for example, it may also overload working memory being more cognitively demanding.

Espéret (1996) says that while in traditional texts readers have “direct access to the physical storage of in-

formation” (p.151), that is, they can physically manipulate volumes and pages, in hypertexts the information is retrieved and displayed by the computer. Such aspect, as Espéret (1996) explains, becomes a significant advantage of hypertexts because “the reader is relieved from the burden of physically manipulating the stored information (p.151)”. Nevertheless, such advantage becomes insignificant when considering that linking content from different sources requires readers to be more skillful and strategic because, as Goldman (1996) explains, external supports, such as maps, graphs and charts, may increase cognitive demands, making processing more difficult. Such cognitive requirement, then, could be considered a major aspect when distinguishing linear texts from hypertexts, mainly when observing that “comprehension is a continuous process” (Dee-Lucas & Larking, 1992, as cited in Rouet & Levonen, 1996, p.15). Nevertheless, again, we could claim that nonlinear reading can occur in both linear texts and hypertexts. The important aspect, then, would be to investigate and try to explain which of these two readings (linear texts or hypertexts) would cause more disruption on the processing, and why.

Disruption can be caused by textual characteristics as well as, in the case of hypertexts, the “formal constraints of the computer system (Kintsch, 1998, p.369)”, which may be imposed to the users. Computers are not familiar environments for many readers, thus, some tasks have to be done *consciously* and *semi-automatically*, causing an extra burden on working memory capacity, affecting processing. Considering the aspect of unfamiliarity, Kintsch (1998) points out to the fact that working with computers require readers to generate three types of nodes in the long-term memory network: general knowledge about

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computers, general knowledge about the task to be performed and, finally, specific action plans which he calls “plans elements”, understood as the commands necessary for task performance. Hence, differently from linear texts, hypertext readers need to have a schema for accessing information on computers.

Although there are some aspects which seem to be crucial for the processing of these two types of texts, as I have already discussed, it is not clear, yet, to what extent these points could be considered essential for establishing boundaries for differentiating the processing of linear and hypertext. Nevertheless, among many aspects which can contribute for an effective, or ineffective processing, individuals’ cognitive characteristics may be considered the paramount.

The importance of individual skills and strategies for the processing of information

Skills are part of the readers’ “declarative knowledge”; the prior knowledge or representations already stored in long term memory, and which are “operated on by processes” (Stillings et al., 1991, p.18). Skills are automatic cognitive processes executed unconsciously by the readers (Stahl, 1997; Tomitch, 2002). They are directly related to processing and comprehension, because among other aspects, skills are used to “identify word meanings, draw inferences, recognize the script of a language, understand cohesive devices, provide structural knowledge and vocabulary (Urquhart & Weir, 1998; Tomitch, 2002), among others. Skills are not taught; readers (in this case) automatically acquire them after a certain amount of exposure to texts, and they may vary from reader to reader.

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Strategies, on the other hand, are conscious and purposeful abilities, which can be developed in class, for example, aiming at achieving specific objectives. Strategies are part of the readers' "procedural knowledge", and they enable readers, among other aspects, to locate specific required information, recognize indicators in discourse, select and extract relevant points from texts, identify writer's techniques and recognize the mood of a passage (Urquhart and Weir, 1998). For any demanding text, readers have to be skillful and strategic if they want to read it effectively. And, the more unfamiliar and opaque the text, the more declarative and procedural knowledge readers need to have, adapting these strategies and skills to the different contexts they are exposed to.

Reading comprehension results from the integration of text base features and mental processes, which have to occur in cycles due to memory limitations. Such integration can be facilitated if readers selectively search for the important information, which has to be kept in focus to be bridged onto representations already stored in memory (O'Brien, 1995). Thus, as Urquhart and Weir (1998) claim, comprehension cannot be understood as only the product of reading, because readers' individual characteristics, that is, their skills and strategies, which are brought to the reading process, are crucial to their performance.

Background knowledge and familiarity with the genre, for example, may activate readers' schemata enabling them to make predictions and inferences about the text, facilitating reading. In hypertexts, besides knowledge on textual aspects, which could facilitate processing, readers are also required to be skillful and strategic at working with computers, since many variables such as the size of screen, polarity, font, stimulus size, number of colors,

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wavelength separation, individual differences (Muter, 1996), among others, may directly influence processing.

Linearity, as already discussed, is considered by many researchers as a facilitator in text processing. However, hypertexts present information mostly in a nonlinear order requiring readers to use different strategies and skills to retrieve, integrate and *monitor comprehension*. As explained by Goldman (1996), at the same time that hypermedia gives readers a variety of sources of reading and information searching it also requires them to “*assume more responsibility* for structuring and organizing the information (p.07) (my stress)”. Thus, less skillful and strategic readers might probably have more difficulty in accessing relevant information and processing it in a hypertext document than in a traditional text, due to the limitations of working memory capacity.

Finally, comparing the processing of these two types of texts we could say that, hypertexts, mainly the ones which do not have hierarchical structures, seem to require overriding attention because, besides the constraints which may be imposed by the text itself, for example, the discontinuity in their rhetorical organization and presentation of information, typical from them, may affect processing, thus, being more demanding in terms of readers’ skills and strategies.

CONCLUSION

Considering the reading theories presented in this study, which claim that certain specific characteristics of textual organization and presentation may directly affect processing, and also taking into consideration that one

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processes texts under the constraints of a limited working memory capacity, it would be reasonable to think that any extra effort brought by the reading context could affect processing at different levels, according to readers and their readings. However, the differences in the processing of linear text and hypertext, if any, seem not to be totally established yet. Nevertheless, some of the researchers' standpoints claiming for extreme differences in the processing of these two types of texts may signal to some possible problems readers may face while processing hypertexts.

It seems to be clear that computer systems may represent a significant constraint for some readers, which do not have specific schemata for using them. Such aspect added to constraints imposed by the task, and also the text, could represent an extra burden for processing, thus, compromising comprehension. However, despite some evidence, discussed in this work, which could be considered as possible differences between the processing of linear texts and hypertexts, more research has to be done in the area to establish precisely, among other aspects, if readers need to develop special skills in handling hypertext, the effects of presentation format and organization of hypertext documents and their impact on processing.

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