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Hypertext and the Representational Capacities of the Binary Alphabet.

The text is an elaborated version of a lecture given at the Humanities at the Millennium-Conference on »Text, Medium, and Meaning«. University of Aarhus, Denmark, May 6.-7. 1999.
The pagination of this pdf-edition follows the pagination of the printed version**:** »Hypertext and the Representational Capacities of the Binary Alphabet«, Arbejdspapirer no: 77-99, Centre for Cultural Research, Aarhus 1999.

Abstract

In this paper it is argued that the relation between the socalled »Gutenberg galaxis« of printculture and the »Turing galaxis« of digital media is not one of opposition and substitution, but rather one of co-evolution and integration. Or more precisely: that the Gutenberg–galaxis on the one hand can be inscribed into the Turing–galaxis, which on the other hand is textual in character since it is based on linear and serially processed representations manifested in a binary alphabet.

In continuation of this text and hypertext is described as notions of related but different sorts of complex systems and it is argued that both texts and hypertexts are best thought of as sequentially organised.

The first part of the paper contains a description of the basic properties of computers and digital representation answering the question: what are the properties common to all kinds of use of computers – whether used for one purpose or another? The second part is concerned with the relationship between printed and elctronic text and the third part addresses the idea of hypertext as systems which exploits modal shifts between node-mode and link-mode as a significant part of the semantics of the system.

http://www.hum.au.dk/ckulturf/pages/publications/nof/hypertext.htm

ISBN: 87-7725-260-8

Electronically published:
Pdf-edition: November 11, 1999.

Content

1. Introduction

It is often said that the principles of hypertext represents an epistemological break with the monolinear seriality of the modern culture of texts, which is described as representing a rigid, rationalistic and repressive tyranny. That we—now at the end of the »Gutenberg-galaxy« of printed texts—are heading towards a new »Turing-galaxy« of electronic media based on nonsequential or multilinear hypertexts which allow the user the freedom of choice in the establishing of connections between different texts, or between different fractions of a text.

The argument is basically that the electronic hypertext (which may include both texts, images, speech and music) allows more than one route from the beginning to the end—leaving the choice of route across the system to the user–while traditional text predefines the sequence thereby depriving the reader of his freedom. In philosophical terms the transition is interpreted as a transition from modernity (print culture) to postmodernity (virtual cyber culture).

If this scheme of opposition is not always explicitly stated nowadays, the reason is not–I assume–that the scheme has been given up, but rather that it is now a widely acknowledged precondition which is often taken for granted.

As documented by George Landow, 1992 and 1997, there is a striking convergence or parallelism between notions developed within postmodernist critical theory (e.g. Barthes, Derrida) and hypertext theory (Nelson and later). But since postmodern vocabulary has been established as a description of the existing corpora of (printed) texts while the equivalent notions in the hypertext vocabulary have been established to describe (a subset of) computerised, electronically stored texts, a reconsideration of the notions and their possible applications seems to be appropriate. For instance, if the notion of hypertext is of relevance to the organisation of printed as well as digitally encoded, electronic texts, and hence conceived of as a principle of meta-textual or intertextual relationships one

might question whether (and eventually how) it can be used to describe significant differences between printed and electronic texts.

On the other hand, one might ask whether the different media allow for different kinds of hypertextual relations. In postmodern vocabulary hypertext (intertextuality) seems to be a purely conceptual phenomenon, denoting possible relations and interconnections on the level of content in the various texts (or rather in human minds), while in the field of computer-applications the notion refers to the externalised and mechanised links between nodes, which are either identifiable servers on the macrolevel or a delimited set of files on the microlevel.

The two notions differ in their focus on content and materialised expressional form respectively, but they both presuppose that hypertextuality is a relationship between identifiable units, whether named texts or nodes. It is assumed that there are units in which there is a content contained in both cases. If there is no difference between printed and electronic texts in this respect, then how exactly do they differ?

The relationship of texts to electronic texts and hypertext includes questions concerning the notions of »author«, »writer«, »reader«, »user«, »writing« »reading« and »text« as well as »browsing« and »navigating«. For instance, the notion of hypertext has been considered both as a notion of a writing principle and of a reading principle, or as a principle for the integration of these procedures and hence close to the notion of interactivity. If hypertext systems (or computer systems in general) mechanise and externalise (some of) the operations of writing and reading, one may also inquire about the possible implications for how we ourselves write and read these writing and reading systems, that is, inquire about computer-literacy and how it relates to literacy.

Further questions can be raised, such as whether the relation between printed and electronic texts is a correlation rather than an opposition (coexistence and coevolution rather than replacement), according to both empirical and conceptual criteria. The survival of some of the traditional paper-based text genres and the

development of new genres, formats and functions of printed texts (for instance as a result of the spread of printers connected to computers) and the widespread use of electronic representations of traditional paper-based text formats naturally give rise to questions concerning, for instance, the advantages of printed texts and electronically stored texts respectively, and the narrative advantages of »textual units« or nodes versus intertextual and hypertextual relations.

While there is no doubt that the computer provides a new »writing space« (Jay Bolter, 1991), it seems that it is now reasonable to ask whether the experiences of the last ten years still fit into the binary opposition between printed and electronic texts or whether it is timely to consider more closely the various propositions inherited in the predominant scheme and eventually bring new considerations into the understanding of the relation between medium, text and meaning.

In the following I will argue that the relation between the Gutenberg galaxis and the Turing galaxis is not one of opposition and substitution, but rather one of co-evolution and integration.

Or in short, that the Gutenberg–galaxis on the one hand can be inscribed into the Turing–galaxis, which on the other hand is textual in character since it is based on linear and serially processed representations manifested in a binary alphabet.

In continuation of this I will describe text and hypertext as notions of related but different sorts of complex systems and argue that both texts and hypertexts are best thought of as sequentially organised. I shall do this in a two-step operation starting with a summary of a description of the basic properties of computers and digital representation given in Finnemann 1994, 1997 and 1999 answering the question: what are the properties common to all kinds of use of computers – whether used for one purpose or another?

After this I will discuss the relation between text and hypertext.

2. What is a computer?

The question is what are the invariant properties of a computer—or what are the constraints which apply to any kind of symbolic content when represented in a computer whether it is text, hypertext, images of any sort, sound, or whatever else?

According to the above mentioned sources one can specify these constraints by the following three criteria:

1. Any process performed in a computer has to be represented in a mechanical alphabet consisting of a finite set of letters, each of which is void of semantic content: If there is a computational process, there will always be a sequentialized series of bits. This is the level of organisation of physical substance as well as of the lowest level of the symbol system. It is the level of real physical performance. Nothing goes on in computers, which is not processed in this way.

2. Any process performed automatically has to be governed by the help of one algorithmic syntax or another: If there is a computational process there will always be an algorithmically organized (formal) syntax. However, there is no single syntactical structure common to every possible computational process. New algorithms can always be introduced deliberately, and existing algorithms can always be modified, suspended, or ascribed new functions and meanings by the help of other algorithms.

3. A computational process is always performed by means of an interface determining the semantic content of the algorithmic (or syntactical) processes as well as of the semantic content processed: If there is a computational process, there will always be an interface. However, there is no single element common to every possible kind of interface.

So we have the following invariants:

- Representation in the mechanical (binary) alphabet
- Algorithmic syntax/formalisms
- Interface

To this we can add that

- We also need machinery which is capable of processing the mechanical alphabet.

These are the general constraints common to any kind of computational process.[1] However, there is an important difference between the three contraints, since it is only the letters of the alphabet which are invariant units while their combinations, the algorithms, and the interface can be varied deliberately. Hence there are no definable built-in restrictions for semantic content that can be represented in computers–except the restriction on the level of the alphabet.

One may wonder why the binary notation is described as an alphabet, and I shall now explain why.

First, one should keep in mind that there are no »zeroes« and »ones«, no numbers in a computer. The two bits are defined as two different electromagnetic, physical values, and they do not function in the same way as the numbers »zero« and »one« used in the binary number system. The binary notation system used in the computer is not defined according to the principles for the use of notations in formal symbol systems.

Used in a formal system the two units are always defined by their data value (as number value) according to the position in the expression. They can never represent a rule for addition or subtraction—for those purposes other notation units are necessary—while in the computer they shall both represent data (numbers)

[1] To compare with a traditional and 'mechanistic' computer science approach see e.g. Dertouzos, (1997) 1998: 349-360. Dertouzos describes the letters of the binary alphabet as numbers, which they are not (see below). He ignores that programmes (called arithmetics or »verbs« p.52-53) has to be treated as any other sort of data (called »nouns«) and that an interface is necessary for the semantic interpretation of the binary sequences. This and other things critised, his book also indicates that the www finally will bring the computer out of the data-departments

and various rules, such as the rules of addition for instance. The two units shall not only represent the rule; they shall also be used to carry out the process of addition in a mechanical way.

The binary units as used in the computer are defined independently of any semantic content and they can never have any semantic value of their own. Semantic content in the computer is always related to a sequence of units never to a single unit, while the latter is always the case in formal notation systems.

The reason for this can be found in the principles of the universal computing machine. As it was principally shown by the English mathematician Alan Turing in 1936 such a machine had to function independently of any specific formal rule or programme (any specific semantic content), since it should be able to perform any rule or programme. If the machine was determined by one or another specific formal rule, it would deprive it the universality.

As a consequence of this there is also another important difference. While we are always free to introduce new units in formal systems - by defining the semantic content of the unit - we are never able to introduce new units in the ”informational“ notation system. The number of units need to be finite since it shall be defined at the time the machine is build - as part of the hardware. The binary alphabet consists of two members, but this is arbitrary, although practical; theoretically seen we could use e.g. 17 or 53. However, once chosen the number of notation units cannot be modified since it has to be specified as a part of the invariant physical machine and not as a part of the editable software.

Some of the most important differences are shown in the following scheme:

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and into the public world of social and cultural media. As part of this process a reinterpretation of the computer is necessary.

Figure I : **Binary notation**

As formal notation system **i.e.: binary number system**	**As used in computers** **i.e.: binary alphabet**
The two digits can only represent numbers (data values). A distinct set of notational units for rules is necessary.	Constellations of the two digits are used to represent both numbers and rules.
Each digit needs to have a semantic value of its own. Units cannot be introduced without a definition of semantic content – eventually defined as a variable relative to a set of legitimate values.	Semantic values are always ascribed to sequences of bits. Meaning cannot be ascribed to a single unit. The two digits never have any semantic value of their own.
New units (representing new rules or values) may be introduced during processing.	New units cannot be introduced during processing. The number of units is finite. Both units are always used in an expression.
Physical form only matters relative to human recognition.	Physical form matters relative to mechanical functionality - and can be defined independently of human perception.

According to this informational notation systems can be defined as consisting of a finite number of members (e.g. the binary alphabet with two members) each of which is defined by an unambiguous physical form and since the units can have no semantic content of their own, they can be used as part of the representation of any kind of content. The very same notation system can be used both to represent formal expressions, (as part of the representation of both data and rules), and the alphabet of ordinary language, pictorial and musical expressions, speech as well as a huge number of non-symbolic phenomena and processes - dependent only on our own choices.

As an effect of this, we are always able to manipulate and edit computer processes on the level of the bits. That is: on a level lower than both the syntactical

level, including the formalisms which define the architecture of the system, and the level of semantic content. Hence, any computerproces can be manipulated independently of the–former–semantic content and the syntactical rules.

This mechanism is known in linguistics as double articulation denoting the asymmetrical function of the letters compared to the word. The point is that the letters can be used to manifest semantic and syntactic content and variation because they are not themselves semantic entities.

The principle of double articulation also explains that the previous processes and programmes in the computer never determine the later processes in a *nonoptional* way.

Of course, most of us would never use the machine, if we were to use it on the binary level. It is not very convenient for us, so we do use programmes and a wide range of in and out-put devices and interfaces to perform many processes. But we do so for our own convenience.

Programmes are used in reducing the *huge number* of possible choices to *a restricted number* of *relevant* choices which are *meaningful* for one or another purpose.

The notation system (and the presence of a computer) represents the only invariant constraint for any computer process. If something can be represented in this system, it can be processed in a computer, and hence we can say that the computer is basically defined by a new kind of alphabet.

Whether this alphabet is used to represent calculations, formulas, letters, and texts, images, linguistic or musical sounds or whatever else, - it is always sequentially processed – and the content is always editable bit for bit.

Computational representations are textual in character.

It has been said that digitisation implies a change from physical marks on a surface to codes. Being so, it is important to note that also the codes have to be manifested and processed as series of binary signals—in exactly the same physical materialisation (or form) as all other sorts of data. As texts.

It means that also the codes, the programmes and the whole architecture of the system can always be manipulated, edited, modified, suspended and over-coded.

This is a very strange relationship. The rules (programmes, codes) which governs the processes can only do so because they can be treated (and edited) as data. Due to this the computer can be defined as a medium in which there are no invariant thresholds between:

- The machine and the material processed by the machine. If there is no software, there is only a heating device;
- The programme and data, since any programme (set of codes) must be represented and executed in the binary alphabet in exactly the same way and form as any other data;
- The information that is implemented in the functional architecture of the machine and the information processed by that architecture;

So, *a fundamental difference between the computer/digital media and other media is* that *the material processed in the computer can be used to change the functional architecture of the machine*. Digital media differs from other media in that the functional architecture of the former always remains variable and capable to be edited (editable) on a par with the mediated content.

Or, in other words: the fact that there is no *invariant* border between the machine and the material processed implies that any of the hidden processes in the machine as well as the processes in the in- and output devices (in short: all parameters) can be made visible and editable as an object for any conceivable kind of editorial change. As a consequence we can also conclude that the principle of interactivity is rooted in the principles of the universal computer.

This also explains why the computer can simulate a huge array of other media, (typewriter, calculator, book, telephone, musical instrument, radio, fax, video, television, and so forth.). However, when these media are simulated in the computer *they cease to be media and become genres* within the new digital medium.

Former invariant properties of a medium here become variable parameters of a genre. The transformation of physical invariants to symbolic variables is important though not the sole characteristic of digitisation. Other »first-time-in-history« features are listed in the following scheme:

Figure II: **A list of »first-time-in history« features**

- An alphabet in which any other alphabet can be represented and processed and in which we are able to represent knowledge expressed in any of the formats used in the prior history of modern societies;
- An alphabet for textualised—serial—representation of any sort of visual and auditive expressions (images music, any sort of other sounds including noise);
- A globally distributed, electronically integrated archive of knowledge represented in any of the hitherto known formats and including the whole range of handling functions (e.g. production, editing, copying, distribution of symbolic representations/ messages/information/knowledge);
- A still evolving set of mechanical and programmable search, sorting and indexing engines which in principle allows any sequence of bits to be used as criterion;
- A still evolving set of mechanical agents and push and pull-mechanisms;
- Random access to any part of the evolving electronically integrated and globally distributed archive of knowledge, enabling among other things an *indefinite amount of different linkages/hypertexts* to be generated (new sequential constraints can always be substituted for previous sequential constraints);
- A functional architecture manifested in the same format as the content.

In this way, computerisation implies a number of conceptual disturbances. Properties which were formerly ascribed to the medium (for instance, the physical features that constitute a telephone as a telephone) now become part of a textualised »genre« or even a part of a specific message.

Properties formerly incorporated in physical forms are now set out explicitly and defined symbolically (for instance, the definition of the function/value of each key on the keyboard). Physically implemented functions are transformed into facultative symbolic functions described and processed in serialised textual form, which can always be edited – modified or suspended.

The process of computerisation implies that the *physically* defined structures become less important or, more precisely, less significant. If a physically implemented and invariant syntactical structure or functional architecture defines traditional machines, the digital machine is only invariant at—or below—the level of the binary *alphabet.* As a consequence, there is always a difference between any medium and a digital simulation of the same medium.

Take as an example the relation between a printed and an electronic manifestation of the same text. While there is no difference on the level of the text—the whole text can always be transferred into an electronic format with out loss of information—there is a difference between the manifestation of the text in two different physical substances and hence in two different media.

I will say a few more words about this difference between printed and electronically stored digitised texts before I come to the questions relating specifically to the notion of hypertext.

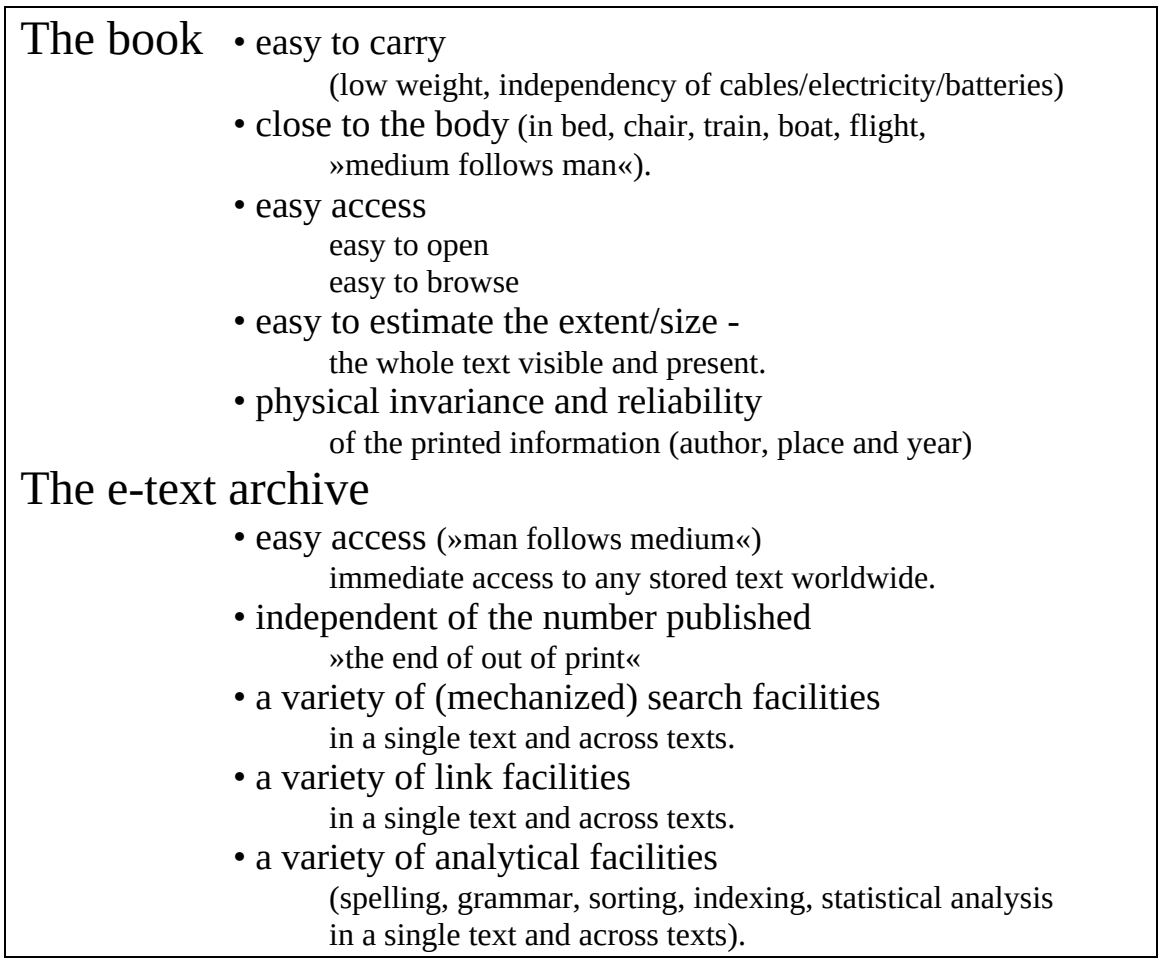
3. Print and e-text.

The conversion from book to electronically stored text takes place without any loss of textual information but at the cost of some the properties of printed media.

In the case of printed text, the medium is paper and eventually a book, which, for instance, is easy to carry, easy to open and browse, easy to estimate in size and extent (the whole text is visible and present) and physically stable and reliable. The content of the book will be the same tomorrow as it is today. None

of this is necessarily true in the case of the electronic version of the »same« text. Take for instance the physical stability, durability and invariance. Furthermore, in the digitized, electronic form a number of physically manifested invariants (e.g. margins, fonts, layout and even the simulation paper on the screen) is transformed into a string of bits which can be edited bit for bit.

Figure III: The Book and the E-text Archive.



The gains from the conversion are a variety of editing and layout facilities, a variety of mechanical search facilities both within a single text and across texts, and a variety of linking facilities. Since new copies can always be generated, we may also add that texts don't need to be out of print any more and—taking the internet into account—that we can now have immediate access to any electronically stored text worldwide.

As a result, printed texts today loose their function as the basic storage medium in society, while in many cases they may still be used as a preferred reading medium.

The relation between printed and electronic text is not simply one of opposition: Most printed texts are nowadays produced with the help of electronic versions, and there has been no decrease in the production of printed texts. On the contrary. There has been an increase including an increase in the amount of paper used for that purpose. As you know, if there is a PC there is a cable leading to a printer allowing the production of paper based texts from almost every desk in the electrified world. The spread of new printing techniques follows the spread of the computer. The road to paper-free offices seems to be quite different from any road leading into the foreseeable future.

So far, the relation between texts printed on paper versus the digitized, electronic text seems to be more like a relation of reciprocal reinforcement than one of competitive and mutual exclusiveness. This is maybe only a transitional phenomenon caused by the slow change of customs on the side of the users and of the—so far—not too convincing visual qualities of the screen. But one could also argue that computerisation implies a renewal in the use of printed texts, supported by easy access to printers which are spread everywhere, and to cheap copies in any number, any place, any time, just-in-time or just a little belated.

In fact, printed texts nowadays appear not only in books and on paper on the desks in the offices, but everywhere: in the factories, in the transport systems (trains, trucks and flights) on the houses, on the streets. Likewise texts are also found on a still growing number of goods—even on the food in our refrigerators and on our clothes.

Actually, it can be claimed that since the second world war and not least since the advent of the personal computer twenty years ago—the use of printed texts have spread into a still growing number of social and cultural domains. It can also be argued that a still growing number of decisions in all areas of society

depends more or less directly on a textual basis, manifested for instance in a still growing number of reports which are put on the desk before a decision is made both in the offices and in our private homes.

There is neither a decrease in the social and cultural importance and significance of printed texts nor in the amount of printed texts produced.

The social functions of printed (as well as of handwritten) texts may have changed in the process, but anyway, it seems evident that the relation between printed and electronically stored texts is not a relation between mutually exclusive, but between mutually reinforcing media.

This is quite normal in the history of media: a new medium only seldom replaces older media but the functions of the older media are often changed, they may be used to more specialised, and eventually new functions. New genres also develop in old media as in handwriting after the invention of print and in painting after the arrival of photography (for other examples, see Finnemann, 1999).

4. The textual character of digital representation.

From the digression on the still continuing importance of the Gutenberg–galaxis I now return to the transition from printed to electronic text and from older to digital media.

In a slightly more abstract way we can say that digitisation of a medium (e.g. printed text) implies a transformation of various physical or material constraints into symbolic variables which are permanently editable and hence allow both optional modifications and suspension.

A basic principle in this change from printed to electronic text is inherent in the structural relation between the representation of the electronic text (or another old medium) as a hidden, digitised text and the multiplicity of its visible representations (on the level of the interface).

Thus, since an interplay between the textual substructure (the strings of bit) and any superstructure on the interface level, (whether textual or not) is indispensable in any computer process, *this interaction is the core of the structural change in the principles of textual representation.*

Hypertextuality, interactivity and »virtual reality« are among the new features related to this structural relation.

A result of this is that the definition of hypertext as based on the choices of the user is a definition which actually refers to the general properties of all sorts of computational representations, including the representation of any sort of text. We can always connect any selection of a text, any string of bits, with any other selection according to our competencies and interests.

But, if the notion hypertext is used in this way everything in the computer is hypertext: the *menu system* for instance, since choosing a command leads the user from the present state to another state (or from one node to another node) according to a users choice - in this case the choice of a specific command. We would also have to include any database and any use of »find« and »search« functions etc.

Even the use of *word processor* should be included, since the typing process both includes the input of a letter at a given position/node and a link that leads to next insertion point/position/node. In the programme the two processes are connected automatically, but this is only because of the convenience. The user normally wants to repeat the same operation over and again.

The user of word processors defines the ordering of the letters in the same way as the user defines the ordering of the sequences in a hypertext system.

Actually, we could say that *any single step on the level of bits,* is hypertextual, since there is a linking of one »node« or »unit« to another.

The basic reason for this very genmeral character of »hypertextuality« is that while the binary alphabet shares linear sequencing with other kinds of textual representation, it is always randomly accessible.

The whole »text« is synchronically manifested in the storage from which a plenitude of »*hypertexts*« can be selected independently of previous sequential constraints. Sequences can always be deliberately selected from a given set of sequences, because any sequence is randomly accessible.

It can be said, that something similar to this is actually also possible to do in our relation to printed texts. We can always select any fraction of a text and establish a connection to any other fraction if we want to. The difference is that the computer provides us with a number of mechanical methods to select and handle all kinds of digitised sequences.

However, if we include all these sorts of practices in our definition of hypertext, we cannot use the notion of hypertext for more specific kinds of use—for instance as a notion for a genre that can be separated from other genres.

For this reason we have to decide whether we will use the notion of hypertext as a notion of all sorts of digitised representations, or solely as a notion of a specific genre which can be distinguished from other genres.

I prefer to use hypertext as a notion of a limited class of applications, as a genre with a set of related subgenres. But this means that one need to qualify the vague and general notion of hypertext as »a structure of blocks of text connected by electronic links, which offers different pathways to users«. (Ilana Snyder, 1996, IX).

5. Hypertext.

To this end I will now turn to the discussion of some of the questions involved in the ideas of hypertext-as-genre taking as my point of departure the definition given in an older textbook, Jakob Nielsen, *Hypertext and Hypermedia* 1991. Though it is not quite new, the basic notions are still in circulation.

»The simplest way to define hypertext is to contrast it with traditional text like this book. All traditional text, whether in printed form or in computer files, is sequential, meaning that there is a single linear sequence defining the order in which the text is to be read… Hypertext is nonsequential, there is no single order that determines the sequence in which the text is to be read.« (Jakob Nielsen, 1991:1).[2]

What Jakob Nielsen has in mind here does not seem to be hypertext as a meta-structure for the connection of different texts or different books. If he thought of hypertext as a meta-structure connecting more than one text he would have to include any collection of texts in his definition of hypertexts. If there is more than one text there is »no single order that determines the sequence in which they should be read«.

In this initial definition a hypertext is defined as a work, a unit, in the same way as we consider a book to be a work, that is as a compositional whole created according to the all-embracing intention of the Author. Text and Hypertext are seen as two different architectures for the same kind of phenomenon. They are comparable to each other because they are different members of the same class.

There is nothing wrong in this approach; it is quite legitimate to consider—at least some kinds of—hypertexts on a par with a text, as compositional wholes. You can actually produce such systems. The problem, however, is not solely that it is a very narrow definition: some of the important advantages of hypertext relate to the meta-textual or trans-textual linkings beyond a single text and beyond his definition.

[2] Nielsen takes the »nonsequential« from Ted Nelson, who refers to the order of writing, while Nielsen refers to the order of reading. The change does not help much. One might also note that the postmodern equivalent (of intertextuality) neither refers to the order of reading or of writing but to the relationship between the texts. As noted by Landow, 1992:3-4, Barthes' idea (in »S/Z«) seems to be that there are so many possible relations between texts that they cannot all of them be inscribed in an all encompassing system of meaning. Barthes argument is based on the—false— idea of the infinity of language, but, the number of possible meanings may still exceed what can be inscribed in an overall encompassing system of meaning. Foucaults idea (in »The Archeology of Knowledge«) seems to be that a text is always caught up in a system of references to other texts, implying that »the frontiers of a book are never clearcut«. (Foucault, 1976: 23).

It is also misleading to define the difference between text and hypertext by opposing sequentiality and nonsequentiality as he does saying that:

Traditional text is »*sequential*, meaning that there is a single linear sequence defining the order in which the text is to be read« while *nonsequential* means that »there is no single order that determines the sequence in which the text is to be read«.

Now, it is actually a fact that a text is traditionally manifested as a linear sequence of letters and words, and that an author normally would expect the reader to proceed word by word, line by line and chapter by chapter. But even so, it is misleading to describe texts as solely or even primarily defined by the invariant, linear sequentiality. And it is also misleading to describe hypertextuality as solely or primarily nonsequential. Let me first address the linearity of the text.

The linear argument is mistaken in more than one respect.

First, it is wrong in the implicit assumption that the reading process is solely and completely controlled by the order of letters on the paper. This is not so. You are, as a reader, free to skip a passage, to jump, to skim, to go to the end, to search, browse, and to focus on selected passages – as a reader you have a variety of possible approaches and ways of reading. The freedom of the reader is much greater than for instance the freedom of a viewer sitting in front of the screen or in the cinema. If the viewer looks away he misses the point. The reader is also in a more independent position towards the text than is a listener who listens to a speech, since the spoken word disappears as soon as it is said, while the text stays at your disposal.

Furthermore, if a reader actually sticks to the sequence defined by the author—he maybe does so because of the gains, *and not* because he is a slave of a mysterious deterministic relation to the printed text.

Secondly, the linear argument is mistaken because the world of texts is not solely or completely defined by the linear sequentiality. This is only one of the organising principles. *Even if it is partly* true for the manifestation of a composite

whole as a novel or a short story, or a poem, *it is neither true for* the texts printed in a collection of poems, in a collection of short stories, in a magazine, in a journal, in an anthology, in a newspaper, nor for the collection of books which we usually call a library not to speak of alphabetically or chronologically organised lists (phonebooks, address-books, files in an archive, subtexts used to comment photographs, paintings etc etc.).

Third, and most important: The argument of linearity is even more misleading when applied to the organization of the meaning within a text. Even if it is true for the letters and the words and the sentences, it is not true for the content of a work.

There is no mono-linear progression, but a complex structure in which the meanings of early passages are often changed and reinterpretated by what is told later in the story. Conversely, the meaning of what is told later also depends heavily on what was previously told or untold respectively. The meaning of symbols, metaphors and metonymes are made more complicated and richer–or more simple–during the process. In both cases the meaning of the early parts of the story may not be revealed before the end (as for example in detective stories).

A text may contain a variety of meanings which can be both monolinear, non-linear and/or multilinear in their organization both on the level of the whole work, and within each chapter and each paragraph and each sentence, and indeed, also within the possible meanings of a single word. One might also add phenomena such as deixis (pointing to here and there in the world outside the fiction, addressing the reader), embedding structures, e.g. nesting of stories in stories, and the intertextual relations between elements within different texts. It is in fact this »non-linear« relation between elements in different texts which led the postmoderns to develop their ideas of the world of (printed) texts as a »hypertextual« world.

Finally, the printed text is a medium which allow us to play with the fictions of time in a variety of ways not least because the external storage of the linear text allow us to relate freely to its various parts, independent of our memory.

As Michael Joyce tell us in the beginning of his hypertext »Twilight – A symphony«

As in most stories a lot has happened before you got here… Here is what I know so far…The stories, insofar there are stories here, move in two central arcs, east towards life (though in the past) and west toward death (though in the future). Above these is something like a dream or mind, a set of sometimes fragmentary, sometimes speculative linkages with their own arcs…This story begins towards its end, yet well after the end of one of the stories…

Since everything said here is said within a few monolinear paragraphs it is - as are most stories - a good example of how to present a nonlinear narrative in a completely monolinear way.

By the way, a mention of the same principle can be found in the beginning of the novel, *Die Blechtrommel*, (The Tin Drum) written by the German novelist Günter Grass in the 1950-es:

You can start in the midst of the story and instigate confusion while moving boldly either forward or backward« (translated from a Danish edition p. 8).

So it is. There has never been any simple seriality and linearity in the universe of meaning and fiction not even if it is imprisoned in a linear alphabet and printed on paper in a book.

In this way, one could ask whether the »tyranny« of linear text is more or less the same as the capacity to build complex meanings and great narratives. One might also ask whether this is not exactly what it is difficult—if not impossible—to do in hypertext systems, because in these systems the »writer« cannot know the road

of the »reader« and therefore he cannot as the narrator build upon or refer to any specific former experiences. The linear argument only applies on the level of letters and of the level of human perception: Times always goes by when we read.

This said, there is of course still a sequence to take into account, but— *turning to the other side of the* argument: that hypertext is nonsequential —sequentiality is as important for hypertexts as it is for texts.

In an ordinary text you are supposed to move from chapter 1, to chapter 2, while in a hypertext you are supposed to choose your own serial order at various stages on the journey. But even so, you still have to choose, you have to determine the order in which you will read the texts and this order will always be sequential. The optional freedom in hypertext systems is not a freedom from sequentialized linearity, since the user cannot make more than one choice at a time. Whatever the user chooses to do, when he comes to the end of his story he or she has always followed only one mono-linear route from a beginning to that end. So, it seems that a hypertext system can only be read in a monolinear way.

The real difference between text and hypertext does not have much to do with the opposition of sequentiality and nonsequentiality, but with the ordering of the sequences – and hence with the criteria and purposes for the ordering. What we have is a change in the relation between author and reader. A new division of labor. Basically, one could say that it is not the Author, but the Reader of a Hypertext system, who is now responsible for the ordering of the sequences.

But, as we shall now see, even this cannot be completely true. The author must consider carefully the range of possible choices offered and present these choices in ways which can make the options meaningful for the user.

In some cases, for instance in an encyclopedia, he can leave the choice of order to the user by providing a find or search function. In such cases only the material is provided by the author/system, while the purpose (and selection of next node) is completely defined and delimited by the user.

The balance between author and reader in defining the purpose (and anchor point of the next link) can be varied in a number of ways. But, if, for instance, one want to generate a good hypertext system-as-a-work—as a compositional whole whether fact-oriented or fictional—it is necessary to take all the different possible routes across the system into account. At least one could ask the question: why provide optional choices if they are not intended to be worth to pursue?

If, at the same time you are also aiming at the articulation of complex human experiences and meanings in that system you really have a difficult job to do, since you cannot use any specific sequential order to ensure that you provide the user what he needs to understand the complexity of the story. The job is much more difficult than that of a novelist or the director of a movie or stage performance, not least if we also (as suggested for instance in Nielsen, 1991,8) want to maintain the principle that any possible link between two nodes in a hypertext-as–work-system should make sense in terms of establishing a semantic relation between the content of the two nodes and not only because of their belonging to the same »global« context. According to this one could suggest as one of the criteria's for a good hypertext system that not only one but all possible passages should be interesting, and that they should stay so, whether passed in the first and in the tenth passage.

When seen from the author’s point of view, he must take the user into account in a more complicated way than before. You have to decide which options you will provide for the reader at various stages and how it should be done. You also need to consider how you can prepare the reader to understand the range of options offered, to ensure that the user will always find himself in a situation in which he actually is both able to–and want to–make a choice, when he needs to. To facilitate the navigating it is claimed that »a low cognitive load is required so that the users do not have to spend their time wondering what the computer will do or how to get it to do what you want« (Nielsen, 1991,4). On the one hand

therefore we have the demand for qualified semantic relations while on the other we have a demand for a low cognitive load. Of course, one can also imagine hypertext systems, in which a high cognitive load is required. This, for instance, would be the case if the choice of the next node is made dependent on arguments or answers to not all to easy questions. See also the listing of some of the possible »axes of variation« in the appendix.

In general, however, the role of the author is to reduce the unlimited optional freedom to a set of reasonable, or attractive, motivated choices, all of which should be worth to pursue – at least if one actually want the user to utilize the possible options.

As the relation to the user is more complicated, the author of a hypertext system should think in sequences in much more elaborate ways than the author of a text. For this reason one could follow George Landow saying that multilinearity is an appropriate term for the conceptual space required of the author of a hypertext system. At least the task is to transfer a multilinear conceptual space (representing the possible scenarios and options = an open future) from the author to the reader from within a single frame—the present state—given that the author cannot know the previous route of the user.

The serial character of reading a hypertext system is of great significance for the creation of complex meanings and/or fictional universes.

One of the most demanding tasks for a hypertext writer to solve, is the design of the modal changes the user needs to perform each time he want to or need to make a choice: that is*: the change from a mode of reading to a mode of browsing or navigating* and back to the reading mode again.

The basic difference between the two modes (a variety of possible reading-modes versus a variety of possible browsing/navigating modes) is of course the difference between the receptive position of the reader and the active position of the chooser (who is brought more or less into a writers position).

But the are others aspects involved. Sometimes we prefer to chose more or less unaware of what we are doing. A hypertext writer should decide whether he will enable the user to choose more or less without awareness, (seamless, seductive) or as in an opposite extreme whether the user should be brought into a position in which he is forced to deliver a complete discursive argument (or brought into a reflexive mode by artistic »verfremdung«) before a choice can be made or whether the user should make other sorts of wide ranging assumptions concerning the question what to do next?

Contrary to the idea that the role of the author is diminished it is increased:

• in predicting the interest of users

• in overviewing a variety of possible routes

• and in developing solutions to the jumps between reading modes and browsing/navigating modes. Should the modal change be swift as in a fictional universe or should it be result of deliberate rational reflections? should the reader be attracted or verfremdet, and by which means?

The modal changes between various sorts of reading modes on the one hand and various sorts of browsing and navigation modes on the other is one of the most important—though so far not too much discussed—themes.

Actually, one might suggest that the change of modality, implied in the conceptual distinction between the node-mode and the link-mode, should be included in the explicit definition of a hypertext system as different to a system of texts as well as to other genres of digital media.

The basic reason to include the change of modality in the definition of hypertext is that the wide definition of hypertext as already said both includes all sorts of computer applications and any collection of texts if there is more than one member of a collection.

The idea is to use the notion hypertext mainly as a notion for a genre of systems which exploits and facilitates the modal shifts between the reading

modes ands the browsing/navigating modes, which at the same time could be seen as switches between the author and the reader modes.

The possibility of modal switches is one of the general properties of the computer and cannot be eliminated. There are also hypertextual facilities in all applications, but in most cases they are only meant to facilitate the adjustment of the settings, they are not meant to be part of the normal use of the application, which in most cases is performed within one mode (e.g. writing in the word processor or calculation in the spread sheet).

In these programs hypertext functions are not meant to influence the content of the processes they are seen as disturbing mechanisms and normally we want applications which can be used without switching mode to often.

But if the modal node-link switches are integrated as meaningful into the normal use of an application, it will be reasonable to define the system as belonging to the genre of hypertext systems.

There are a few reasons more to stress the role of modal shifts in the definition of hypertext systems as a specific genre:

- First it would help to solve the dilemma of opposing text and hypertext. The dilemma is that the notion of text is a necessary part of the notion of hypertext. If there is no content (texts, images etc.) there is no node.

  A hypertextual relation can *be a relation between different texts* as well as between *different parts within a text* as well as between *selected parts in different texts*, - but – it will always include the notion of a text understood as logical compositional unit that is linked to another compositional unit. Even if the content of a node isn't a text—or is not solely texts—the node itself can be considered as a compositional whole, as a work with a textual basis, defined as a series of identifiable strings of bits.
- Second, because the optional character of the relationship between nodes implies that the user considers a number of possible options which brings him into a meta-textual relation towards to each node.

> The introduction of links implies the introduction both of a reflexive and of a self-reflexive mode: the question what to do next is accompanied by questions such as what are the possible options, what does the system provide, what are *my* present purposes, would *I* like to proceed within the universe of the present node, to quit or to switch to another universe and if so to which?

The modal changes can be varied according to a number of different parameters, which may be more or less relevant depending on the content and possible purposes of the system. But they will always be a significant part of the system. The change of modality is the raison d'être of a specific kind of systems. Why not call them hypertext systems?

Appendix: Axes of variation in hypertext systems.

Figure IV: **TIME:**

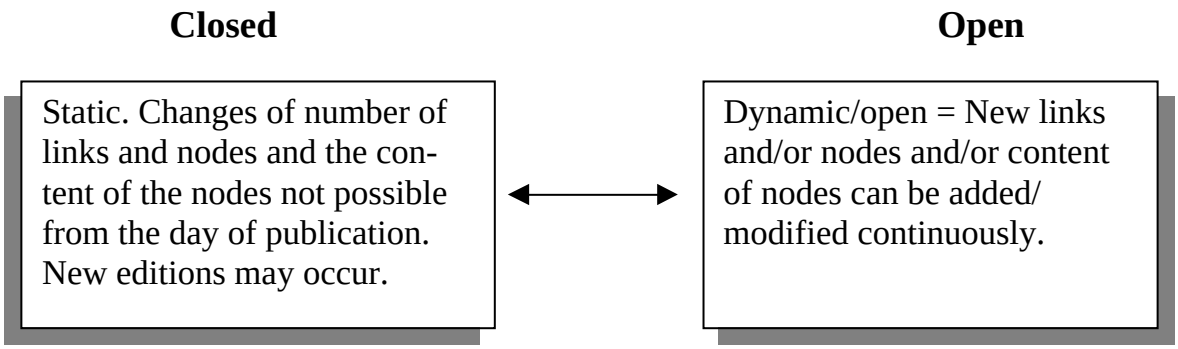


***Figure V*: AUTHORSHIP:**

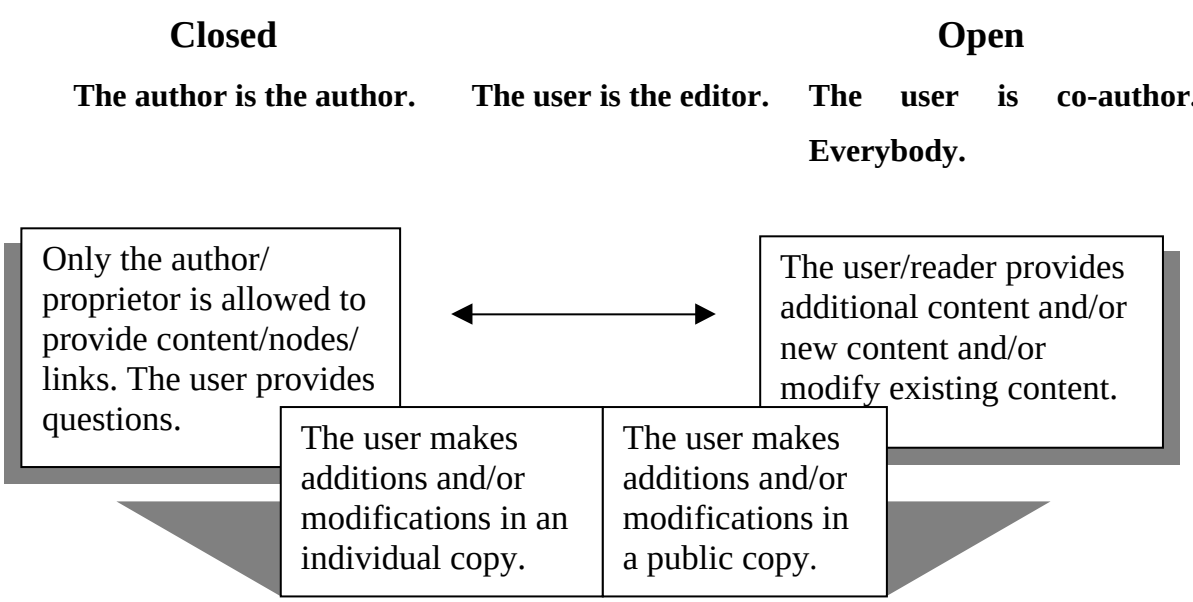


Figure VI: **FACT/FICTION**

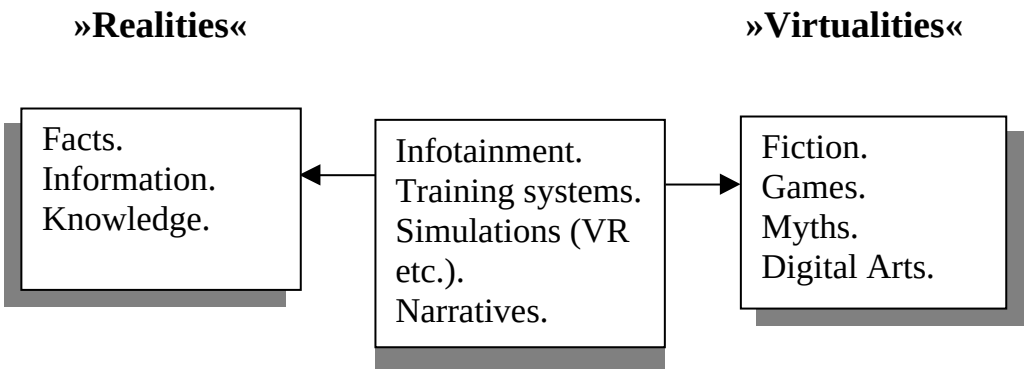
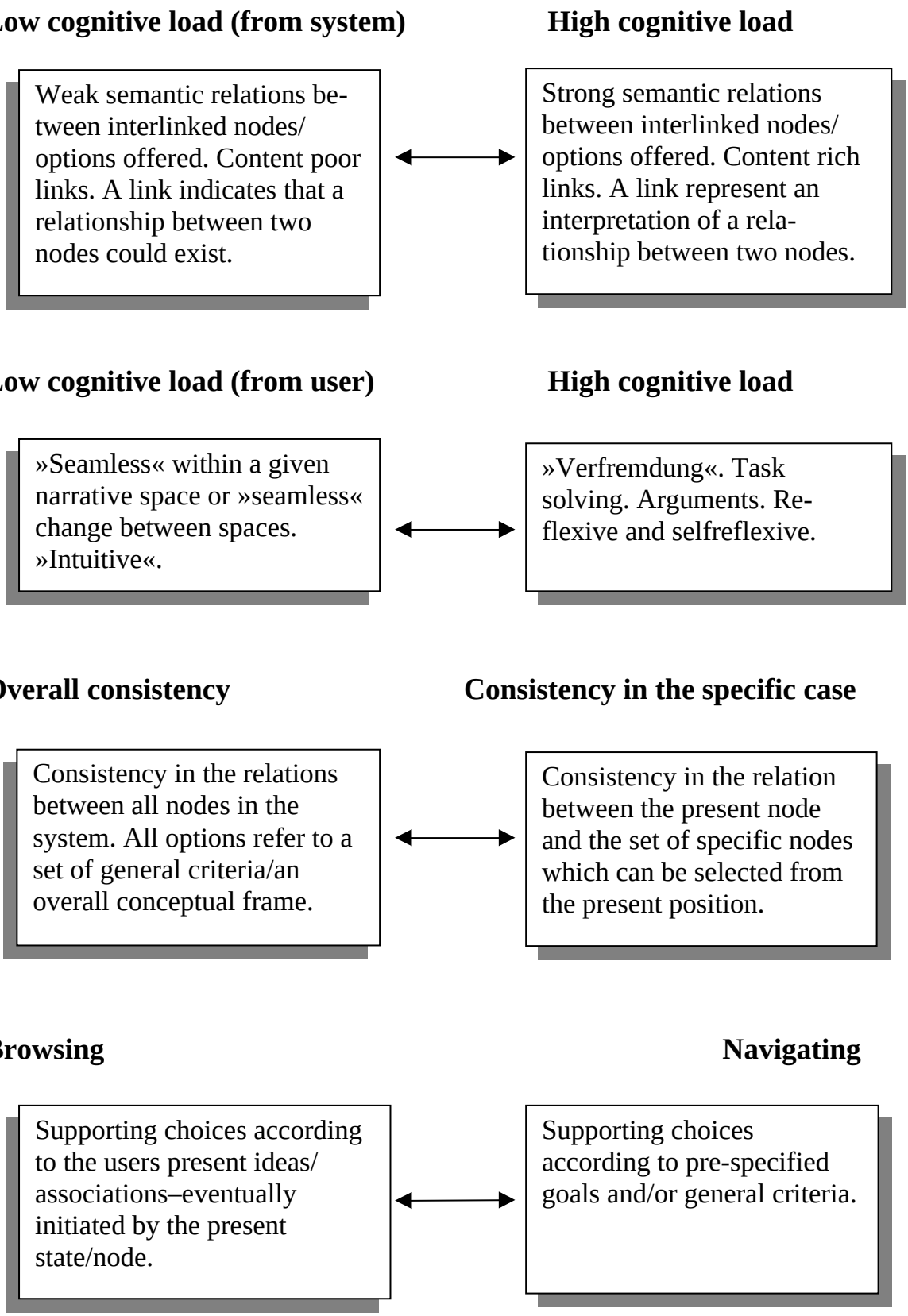


Figure VII: **PRINCIPLES FOR MODAL SHIFTS IN THE SEQUENCING**

Cognitive activity necessary for the selection of next node.



Compositional wholes **Arbitrary collections**

»Works« **»Libraries«**

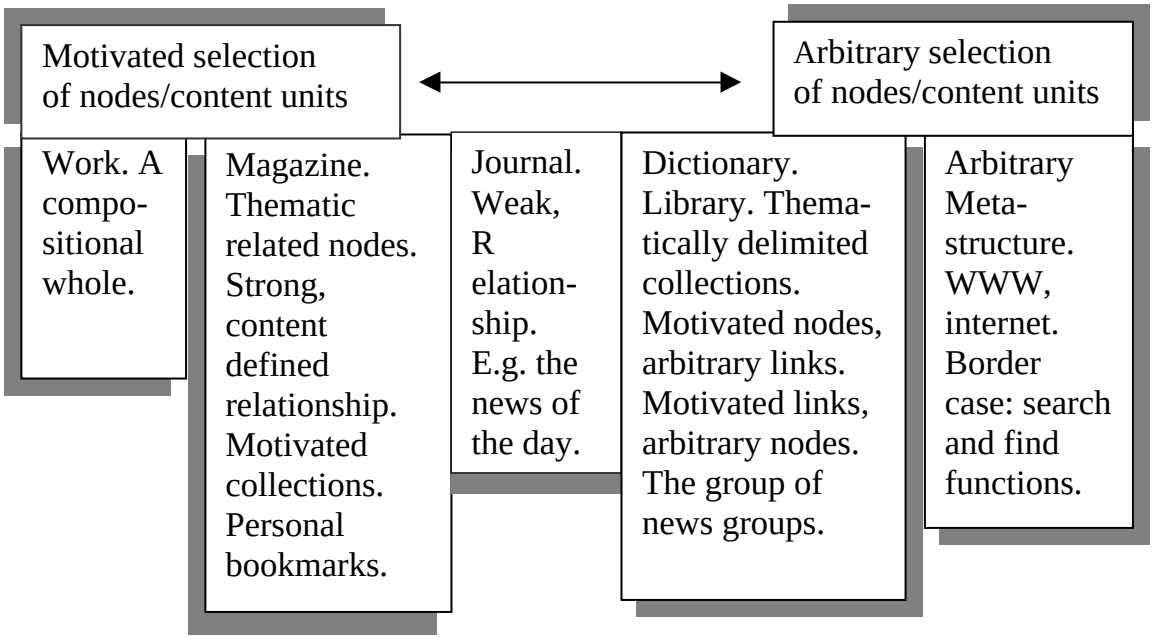


Figure VIII: **REPRESENTATION OF THE USER IN THE SYSTEM**

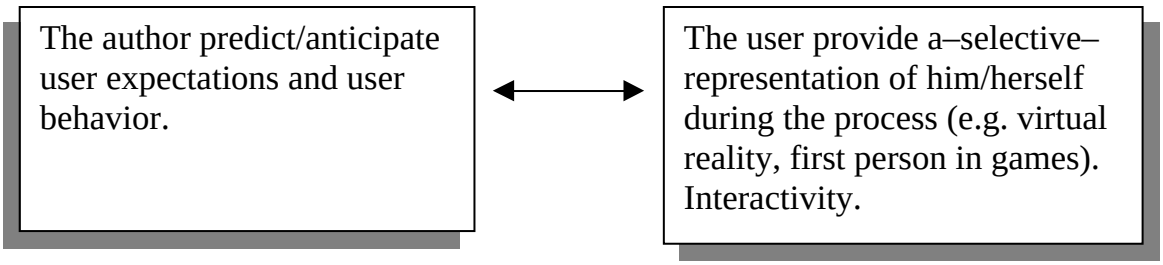


Figure IX: **PUBLIC-PRIVATE:**

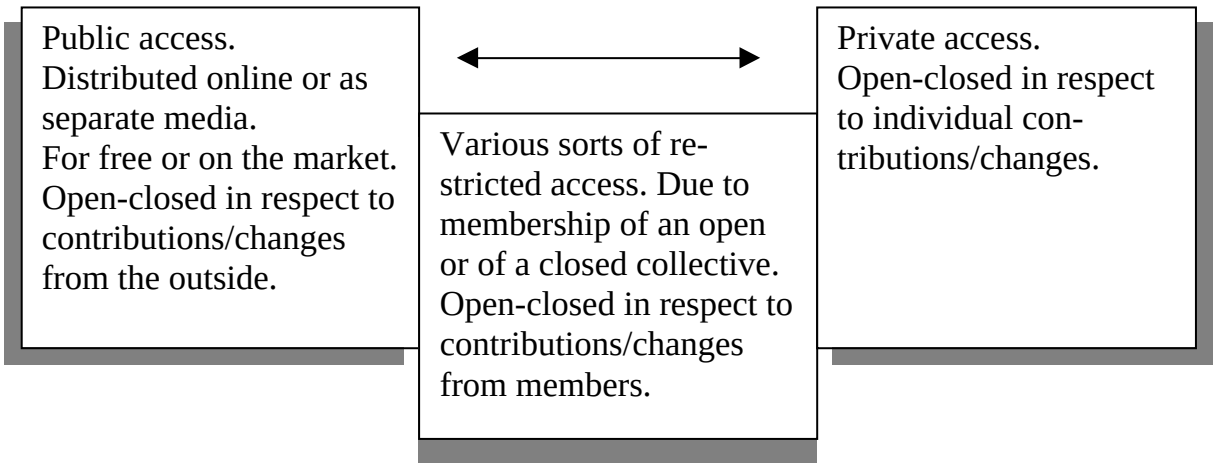


Figure X: **The composition of nodes.**

Scales of possible differentiation

- Depth of the content
- Depth of architectural changes/options facilitated by the interface
- Point of views - for instance according to
  - different interpretations
  - different social, cultural, ethnic and/or religious parameters etc.
- Various Audiences
  - children/adults
  - social, cultural, ethnic, national and/or religious groups.
- Choices relative to the material presented
  - various representations of an »orginal«
  - choice of (simulated) media (audiovisual apparatus)
  - the positioning of computers (foreground/background)
  - narrative principles (use of speech, texts, diagrams, graphs,pictures, music, other sounds, information-like/storylike presentation.
- Interactivity
  - relative to depth of information/knowledge
  - relative to depth of architectural changes facilitated
  - relative to choice of routes (hypertext)
  - relative to representation of the individual user
    (sensivity to the competence of users, use of biographical information, retrieving and editing facilitites, virtual reality)
  - relative to use of pull and push mechanisms.
- Interface, in- and output devices
  - Command based interfaces
  - Iconographic interfaces (GUI)
  - Touch Screens, Virtual Reality interfaces, other in- and output devices

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