Multimodal design

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Multimodal design: Media structures, media principles and users' meaning-making in newspapers and net papers

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Abstract

Modern media messages are visually *fragmented*: they are built up of various visual elements and units. Media messages are also *multimodal*: they contain delimited parts of text, static and dynamic pictures, graphics and auditive parts. Moreover, media messages are *multisequential*: they offer various entry points and reading paths. All these characteristics influence the reception of media messages. In our contribution, we summarize relevant media design principles and theoretical and applied works on media structures. We show the effect of design principles on readers' behaviour and meaning-making. Finally, we discuss the relations between media structures, design principles and different ways of reading.

1. Introduction

Modern media messages are visually *fragmented* since they are built up of various visual elements and units (Holsanova/Nord 2010). This tendency has also been described as atomization of news texts (Knox 2007) or as modularization of the text design (Bucher 2000). Media messages are also *multimodal* in the sense that they contain delimited parts of text (articles, headlines, briefs, lists of items, fact boxes), static and dynamic pictures and graphics (photos, drawings, diagrams, graphs, maps, films, video clips, animations, typographic and layout elements) and auditive parts (speech files, sound, music, etc.). Moreover, media messages are *multisequential* since they offer various entry points and reading paths. Thus, there is no obvious linear order in which these messages should be perceived. All these characteristics influence the reception of media messages. The following questions arise: How does the reader choose entry points and reading paths,

and navigate in the media? How does the reader create coherence in the fragmented message? How does the reader integrate information coming from different sources (text, photos, graphs, etc.) in the process of meaning-making?

In our contribution, we will summarize relevant media design principles coming from various design disciplines (information design, document design, multimedia design, web design) but also theoretical and applied works on media structures coming from media discourse, social semiotics, rhetoric, literary science and discourse analysis (section 2). A special focus will be on cognitive principles underlying media design, promoting interaction, integration and understanding of the message. Further, we connect production and reception perspectives and discuss the effect of media design principles on readers' behaviour and users' meaning-making (section 3). In particular, we show how the spatial proximity principle, the signalling principle and the dual scripting principle can support the reader, attract the readers' attention, provide attentional guidance throughout the message, and facilitate information processing and semantic integration of the complex material. Finally, in section 4, we will discuss the relations between media structures, media design principles and different ways of reading.

2. Media structures and media design principles

Experts in information design, interaction design, document design, instruction design, multimedia design and web design have formulated many principles that are relevant and can be applied for an effective and functional media design. In this contribution, however, we will not cover the whole spectrum of design principles. That would not be possible. Pettersson's (2007) studies of processes of information design alone resulted in 16 design principles and 150 guidelines for the production of information and learning materials and instructions. Instead, we will confine ourselves to principles specific for the design of *printed* and *digital media.* Also, we will focus on *compositional* and *navigational aspects* rather than on the function of individual design elements (such as colour, contrast, lines, texture). Finally, we will focus on *cognitive* and *communicative aspects* of design. In particular, we

will extract principles that are relevant for users' interaction, meaning-making and understanding of the material.

2.1 Theoretical inspirations for design

The design of media messages can serve various functions: to inform, explain, instruct, persuade, sell and entertain. The aim of most designers is to create an aesthetically appealing, effective and user-friendly design that makes it easy for the user to find, process and understand information. A functional design should help the users to accomplish their personal goals—get informed, perform an action, solve a problem, make a decision or learn something.

Design is not only a *product* of the design process, an organized arrangement of one or more elements (for example lines, colours, textures) that has been created in order to serve a certain purpose. It can also be conceived of as a *starting point* for interpretation processes (Bucher 2007) since it invites the user to a certain interaction. In this connection, the notion of *affordances*, originally coming from ecological psychology (Gibson 1979), has often been applied in design. This notion indicates that all artefacts in our environment contain functional attributes that can be perceived and acted upon by humans (for instance perceiving a door handle as graspable or as turnable invites us to different interaction). Simply put, to afford means »to give a clue« (Norman 1988). In the case of printed and digital media, the user recognizes functional patterns and principles behind the structure, knows where to look for specific things, how to find entry points and possible reading paths, how to recognize information hierarchies, etc. Thus, the structure of the media offers the reader certain directions, suggests meaningful units, shows possible ways of exploration and guides the reader towards interesting or promising items.

For the designers, these structures give an opportunity to communicate with the users. Media messages contain various kinds of *cue structures* (headings, italics, key words, lists, summaries, diagrams), revealing the *affordances* for the use of the materials (Kirsh 2005). These devices structure the contents, guide users' attention and navigation, orient the user, train the user to expect and subsequently find helpful reference materials spatially distributed at certain locations, and help users in their planning process. Kirsh alludes to Vygotsky's *zones of proximal development* when stating

that »Interaction can be designed to improve ›the proximal zone of planning‹—the look ahead and apprehension of what is nearby in activity space that facilitates decisions« (Kirsh 2005: 147). This also means that design can contribute to users' *metacognition* (i.e. users' awareness of their own thinking), associated with planning, monitoring, evaluating and repairing action. Thus, from a communicative and cognitive perspective, functional visual design with an effective cue structure can control user behaviour, affect workflow, support learning and contribute to better comprehension and performance.

Principles of interaction design are strongly influenced by the research on cognitive models, mapping and affordances and by laws of visual perception and Gestalt psychology. Before we start with a description of the design principles, let us therefore briefly elaborate on these areas of research. *Mental models* are our concepts about the world. They are models of external reality that are built up from perception, imagination, knowledge, and prior experience and that can be changed and updated (Johnson-Laird 1983; Gentner/Stevens 1983). Mental models are used to make decisions in unfamiliar situations and to anticipate events. They also help us to understand new experiences. It has therefore been concluded that it is important to outline the design according to the users' mental model, i.e. the way the users conceptualize how everyday objects and situations are structured or how a system works.

Mapping concerns the correspondence between objects in the real world and objects in the representing world (Palmer 1978). A representation is defined through its structural correspondence to what it stands for and is hence analogical to the real-world referent (Gentner 1999). By means of this analogy, representations can act as a substitute for the referent and evoke responses similar to those evoked by the real-world referent. This source of theoretical inspiration is in turn connected to Charles Sanders Peirce's (1960) work on iconic, indexical and symbolic relations between the representation and the sign object. Applied to interface design, for example up and down arrows represent the up and down movement of a cursor; an opened letter means *get mail* whereas an paper-folded aeroplane means *send email.*

Another prominent source of influence for formulating design principles comes from *Gestalt psychology.* According to Gestalt psychology, humans have the ability to recognize figures and holistic forms instead of collections of lines. The organizing principles which enable us to perceive

the patterns of stimuli as meaningful wholes are defined as (a) proximity, (b) similarity, (c) closure, (d) continuation, and (e) symmetry (Köhler 1947). For instance, the proximity principle implies that objects placed close to each other appear as groups rather than as a random cluster. The similarity principle means that there is a tendency for elements of the same shape or colour to be seen as belonging together. Finally, the symmetry principle means that regions bounded by symmetrical borders tend to be perceived as coherent figures.

2.2 Design principles

In the following, we will extract relevant recurring cognitive principles coming from interaction design, interface design, multimedia design, and web page design. The common goal for functional design is to make the user's interaction as simple and efficient as possible. Thus, for example interaction design includes principles of *visibility* (providing visible functions will more likely make users act in an appropriate way), *feedback* (giving various kinds of feedback on the accomplished action will allow the user to continue with the activity), *constraints* (restricting the kind of user interaction that can take place at a given moment), *mapping* (providing a clear relationship between representations, for example buttons and controls, and their effects in the external world), *consistency* (using similar elements to achieve similar operations) and, finally, the above mentioned principles of *affordances* (giving *clues* to the users about how to use the artefact) (Norman 1988; cf. also Preece/Rogers/Sharp 2002). Similar principles are proposed in multimedia design (Schwier/Misanchuk 1993) and web design (Nielsen 2000): *simplicity*, *clarity* of language and instruction and *consistency* (concerning style of presentation, placement of items such as navigation devices, use of colour, access structures such as headings and cues, style of graphics, terminology, names of commands and manner of evoking them, interaction behaviour required, grouping objects with similar functions together in one spot).

Principles for users' guidance leading to a *reduction of cognitive processing load* are formulated in yet another area of instructional design, in particular in multimedia learning theory (Mayer 2005) and cognitive load theory (Chandler/Sweller 1991; Sweller et al. 1998). According to these theories, instructional materials should be designed to support the integration of

pictorial and verbal representations into a coherent mental representation. Cognitive load theory provides guidelines for instructional design with the aim of encouraging learner activities and optimizing performance. The cognitive load is determined either by the nature of the material being learned and the expertise of the learner (intrinsic cognitive load) or by instructional design, organization and presentation of information (extraneous cognitive load). Multimedia learning theory specifies which cognitive processes learners are actively engaged in when constructing a coherent mental representation of their experiences and suggests that instructional materials should be designed to enhance these processes (see Schnotz/Bannert 2003, on text and picture integration). The above-mentioned principles are inspired by mental models, affordances and Gestalt theory. They also allude to research on the restricted capacity of human working memory and the role of focus of attention.

Let us mention three principles within instructional design of multimedia. One important principle is the *spatial contiguity principle* (inspired by the Gestalt law of proximity) which postulates that »people learn more deeply from a multimedia message when corresponding words and pictures are presented near rather than far from each other on the page or screen« (Mayer 2005: 183; cf. also Chandler/Sweller 1991; Moreno/Mayer 1999; Sweller/Chandler 1994). Designs that ignore this principle are referred to as *split-attention designs* (for example Sweller et al. 1998) and are cognitively much more demanding for the users.

A second, even more *active* attention-guiding principle is the *signalling principle*: »people learn more deeply from a multimedia message when cues are added that highlight the organization of the essential material« (Mayer 2005: 183). Several signalling techniques can be used to guide the learner's attention, such as providing headings, lists of the main steps, and a spoken emphasis on key words. It has been further suggested and experimentally tested that attention allocation to relevant parts of a complex presentation (where to look and when) can be directed by textual reference to the illustration, by a keyword or label, by graphical means such as arrows, pointers, and speech bubbles, or colour coding (De Koning et al. 2007; Folker/Sichelschmidt/Ritter 2005; Jeung/Chandler/Sweller 1997; Kalyuga/Chandler/Sweller 1999).

Thirdly, inspired by the spatial contiguity and signalling principles, Holsanova/Holmberg/Holmqvist (2009) propose the *dual scripting principle*: »people will read a complex message more deeply when attentional guid-

ance is provided both through the spatial layout (supporting optimal navigation) and through a conceptual organization of the contents (supporting optimal semantic integration)« (Holsanova et al. 2009: 1217). This principle involves not only providing layout cues but also restructuring the message itself in order to assist the reader and to optimize the proposed meaning-making. A coherent, conceptually pre-processed spatial format can guide the readers and contribute to easier processing of the materials.

2.3 Media structures

It is not only designers who have formulated ideas, assumptions and recommendations concerning functional design. Researchers coming from media discourse, social semiotics, rhetoric, literary science and discourse analysis have also analysed complex media structures in various applied and theoretical studies and suggested meaningful units and probable reading paths. Their analyses offer concrete examples of how design principles can be applied in various types of texts and media. When synthesizing the findings, we will relate three aspects of the communication process: *design actions*, *means* in the media structures and the achieved *effects* in the reception of the media messages (cf. Chart 1).

In the socio-semiotic tradition (which builds upon ideas from the Systemic Functional Linguistics of Michael Halliday), the view of the multimodal text as an interactive meaning potential of verbal units and visual means of expression has drawn attention to how texts are designed to signal relevant reading paths and indicate the relevant relations between elements. Kress and van Leeuwen (1996) present a model for analysing the meaning of a composition based on three interrelated components: *salience* (assigning hierarchy and weight to elements by means of relative size, contrast, colour and foregrounding/backgrounding), *framing* (dividing and connecting elements on the page by visual means such as framing lines, dividing lines and empty space) and *information value* (attributing meaning by spatially positioning elements on the page). The information value of the semiotic space follows three separate dimensions. In the vertical dimension, general information is found at the top, graduating down to more specific information at the bottom. The horizontal dimension has *given* information on the left and *new* information on the right. In the third di-

mension, the most important information is placed in the centre and less important information outside the central position, in the periphery.

Holsanova et al. (2006) extracted general assumptions about reading paths from Kress/Van Leeuwen's (1996) theoretical model on the meaning of composition and compared these assumptions with actual reading behaviour on newspaper spreads by means of eye tracking methodology. Some assumptions about entry points and reading paths on a newspaper spread could be confirmed (i.e. readers followed elements linked by *framing* devices, readers generally looked for graphically *salient* elements such as headlines and photos). Some of the assumptions, however, could not be confirmed. For instance, readers did not scan the semiotic space before taking a closer look at certain units, and advertisements did not attract readers' attention despite salience in colour and font size. By using their expectations and genre knowledge, readers have already learned to ignore advertisements. This exemplifies the complexity in the relation of media structures and media reception: it shows that users take an active part in the interpretation process (according to their goals and expectations) and are not merely affected by unconscious bottom-up processes. In perceptual and cognitive terms, this can been seen as a competition between *relevance* and *salience*.

The structure of digital hyperworks as well as paper texts with hypertext features, and the navigation related to these multisequential structures was studied by the literary scholar Anna Gunder (2001), who has developed the ideas of Landow (1997). According to Gunder, texts consist of several *content spaces*, i.e. »windows« containing various textual elements, such as video clips, pictures, typographic signs, sound, etc. Content spaces often contain links, i.e. explicit connections between places in the text, that guide the readers' navigation, i.e. between a sentence in the main text and a specific footnote, between one web page and another, or between the first page of a newspaper and a certain page in the newspaper. In multisequential texts where the reader has several options and alternative routes to choose between, the sequence of textual elements varies from reading to reading. Gunder (2001) distinguishes three main types of multisequential structures: *axial, network and lateral* structure. An *axially* structured text typically contains links and one principal, superordinate monosequential text.[1] The reader may leave the main track in order to get further information

1 It should be noted that even in a monomodal, linear text, the reader can jump over certain passages and read it in a non-sequential order.

from the footnote but always has to come back. An article with footnotes or an academic dissertation are examples of an axially structured text. In *network*-structured texts, the reader navigates in a net-like structure of content spaces. The links are obligatory in network-structured texts. Digital hypernovels and websites are examples of network-structured texts. Characteristic of a *laterally* structured text is the absence of links between content spaces and the absence of a main track. Content spaces are usually less dependent on each other than content spaces in network structures. A newspaper, an anthology, a magazine issue, or an encyclopaedia are examples of mainly laterally structured texts. When looking back to the design principles, it seems that axial and lateral structure provide more constraints and guidance.

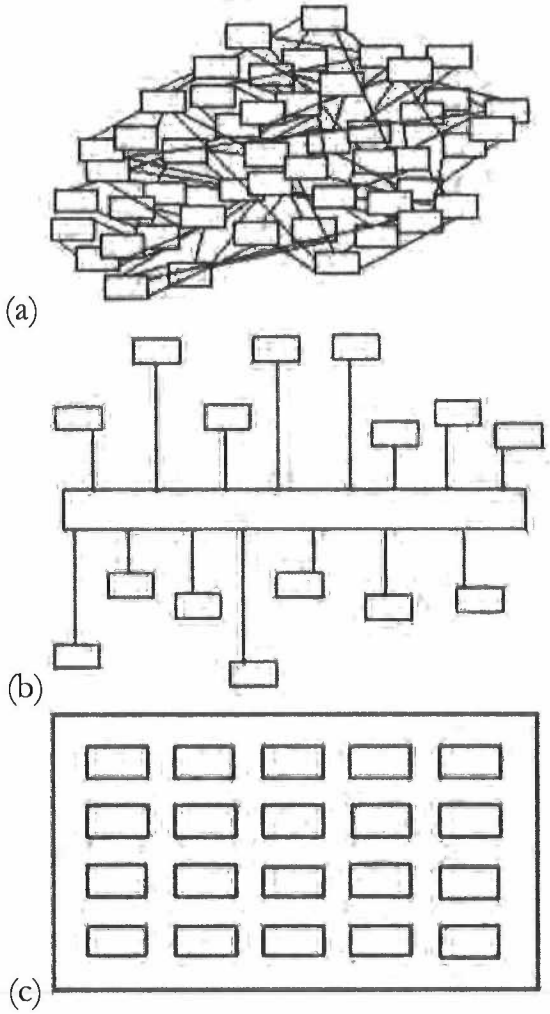

Figure 1: Multisequential structures: (a) axial, (b) lateral, (c) net structure.
(Source: produced by the authors)

In direct connection to these multisequential structures, let us briefly mention results from studies on web navigation (de Léon/Holsanova 1997) and net paper reading (Holsanova/Holmqvist 2004). These studies show that web users and online readers can run into problems orienting themselves in the complex net structure. The problem is that they cannot create a mental map and differentiate between the subjective path taken through the media and the objective underlying hierarchical structures. Thus, navigation becomes cognitively demanding. The online readers therefore use the first page as a hub and alternate only between the first page and the article pages in an up-and-down manner (Holsanova/Holmqvist 2004). As a result, their actual navigation in the hyperstructure of the net paper resembles the axial structure mentioned by Gunder (2001).

In a historical study of multimodal coherence and integration in Swedish garden books, Nord (2008) investigated the hypertextual structures and identified three groups of symbolic linking devices that connect elements of different modes: (a) *visual links* (lines and arrows indicating connection between two spots in the material), (b) *indexical links* (numbers, letters or reference marks explicitly assigning a connection between a figure and the running text, a table and the running text, a footnote and the running text), and (c) *metalinguistic links* (indicating connections between parts of the material, for example »See the picture on the next side!« or »as the figure indicates«). Metalinguistic links can be interpreted as instructions to the readers as to where their attention should be moved to next. The investigation showed a change from a rigidly axial structure in the nineteenth century, where all visual elements were connected to the running text by means of explicit linking, to a more fragmented, lateral structure in present-day books, where links were lacking, and coherence was established by framing and rhetorical clustering.

In the rhetorical tradition (which builds upon ideas from the Rhetorical Structure Theory of Mann/Thompson 1988), the focus lies on the description of the *rhetorical relations* between parts of written coherent documents. Examples of such relations are background, elaboration, evaluation, motivation, contrast, evidency and summary. As a result, a rhetorical analysis offers the sense of unity, connectedness and coherence of a written document. Schriver (1997) recommends grouping semantically related information into reader-oriented functional units called »rhetorical clusters« (for example verbal instruction with illustration). Bateman (2008) extends the RST tradition by presenting an analytic-synthetic model of complex

multimodal documents. He suggests a series of postulates for best practices in multimodal document design in connection with document genre.

Further tools for signalling the structure of the composition are *visual rhyme* and *visual contrast*, which have to do with visual similarities or contrasts due to colour, size, layout etc. One example is a newspaper layout where a pro/contra macrostructure functions as a preview for reading and interpretation (Bucher 2000); another is modern garden books, where specific colours are used to indicate pages with hands-on practical information (Nord 2008).

In this section, we have extracted central principles relevant for the design of printed and digital media and connected them to media structures identified as concrete instances of how design principles have been applied in media messages. To summarize, design creates prerequisites for the use of media messages. Design is communication and needs a recipient, or user, who interacts with it and co-creates meaning. How do designers form messages so that users easily understand the contents and interact appropriately and effectively? Below is a functional synthesis of the above-mentioned design principles and the realized media structures.

Recommended design action	by means of	in order to achieve
A. Show interaction possibilities	visible functions, buttons, links, clues to how to use it	effective interaction
B. Show content structure composition and organization of the message	transparent structure, macrostructure, pro/contra composition, visual rhyme, visual contrast, paratexts	better orientation, overview, preview, improved planning and metacognition
C. Highlight the most important information, relevant parts of the message	keywords, lists, headlines, hierarchies, salience, signalling, cues	better orientation, navigation, understanding, alignment with mental models, better performance
D. Suggest meaningful units, show integration of (modally different) elements	clustering of information that is semantically related and should be read together, spatial contiguity, framing, visual borders, attentional guidance, metalinguistic means: textual reference, graphical means: arrows, pointers, speech bubbles, colour coding	better orientation, integration of information coming from various sources, creation of a coherent mental schema, better understanding
E. Show navigation structure (where to go and how to come back)	linking, marked entry points and reading paths, spatial layout, perceptual and conceptual guidance	better orientation and navigation
F. Restrict the number of simultaneous choices	active attentional guidance, perceptually marked optimal reading path	better focus, understanding and performance, reduced split of attention
G. Reduce cognitive load (take the burden off the user)	avoiding split-attention formats, being consistent concerning the use of names, access structures (macrostructure, cues, textual coherence and cohesion)	easier interaction, better understanding
H. Take into account users' expectations and align design according to them	follow genre conventions, use an outline that adapts to users' needs (most important information first, introduce unknown information, choice of language and terminology)	

Chart 1: Relation between design action, means of media structures and effects in the reception of media messages.

3. Connecting production and reception perspectives: users' meaning-making

In the previous section, we summarized the research on media structures and principles relevant for the design of printed and digital media. The question is, however, what effect these design principles have on users' behaviour. In this section, we will connect production and reception perspectives and discuss the effect of media design principles on users' interaction and meaning-making. In particular, we will show how the *spatial proximity principle* and the *dual scripting principle* can support the user, provide attentional guidance throughout the message, and facilitate information processing and semantic integration of the complex material.

3.1 Eye tracking methodology in visual design

So far, few studies of authentic reading behaviour have been conducted. There is still little evidence about how readers interact with various media formats, how they integrate information from various information sources, and how they create coherence in the process of meaning-making. One of the reasons is that the traditional methods such as introspection, observation or think-aloud protocols cannot assess in detail the rapid and automated processes underlying users' interaction. One of the suitable methods for this purpose is the *eye tracking methodology* that has become a very important tool in the study of human cognition.

Eye movements give us insight into the allocation of visual attention in terms of which elements are attended to, for how long, in what order and how often. It has been suggested that what is being fixated by the eyes indicates what is being processed in the mind (Just/Carpenter 1980). Eye tracking can thus provide data concerning perceptual and cognitive processes underlying various tasks and allow us to trace exactly the process of the users' interaction with a complex material. In other words, eye movements offer us a »window on the mind« (Holsanova et al. 2008). Eye movement protocols can be combined with concurrent or retrospective verbal protocols and interviews in order to reveal the rationality behind the behaviour, reading habits, preferences, and attitudes to the media (Holsanova/Holmqvist 2004; Holsanova et al. 2006; 2008).

In applied research, eye tracking methodology has been used to study the processing of information from multimodal sources (Holsanova 2007), to explore users' problem solving (Grant/Spivey 2003), decision making, visual perception and cognitive processing of print and digital documents (Holmqvist et al. 2003; Holsanova/Holmqvist 2004), to examine readers' choice of entry points and reading paths (Holsanova et al. 2006; Bucher et al. 2007), and integration of text and pictures (Holsanova et al. 2009).

3.2 User-friendly design and attentional guidance

In most complex materials, there are no explicit cues about connections between text and illustration to instruct the reader. When the eyes reach a certain point in the text, it is the reader who has to discover the semantic relations between the text and the graphics. With eye tracking methodology we can trace the process of reading and scanning, cognitive processing of complex materials and conclude whether the users succeeded in finding and semantically integrating relevant parts of text and pictures (Hegarty/Just 1993; Holsanova et al. 2008). This is important since it is not self-evident that all users can automatically integrate text and pictures. For instance, an eye tracking study conducted by Hannus and Hyönä (1999) shows that high-ability pupils were significantly better at integrating text and graphics in biology textbooks than their low-ability peers. This indicates that connections between text and graphics that are not explicitly signalled may be difficult to follow for some readers.

The question then arises, how complex materials should be designed in order to guide and support the users and make it cognitively easier for them to integrate information from different sources. In the area of multimedia learning and instruction design, researchers have formulated principles reducing cognitive load and promoting text/picture integration (cf. section 2). In the following, we will be concerned with two of these principles.

Holsanova et al. (2009) present a naturalistic study on reading information graphics, where two pairs of information graphics have been designed to study the effects of the *spatial contiguity principle* (Mayer 2005: 183; cf. section 2) and the *dual scripting principle* (Holsanova et al. 2009; cf. section 2), suggested as an extension of the signalling principle. Two versions of the same authentic-looking newspaper were used consisting of 15 spreads with

built-in information graphics that were subject to manipulation. Informants read one of the newspapers at their own pace.

Spatial contiguity principle

The information graphic concerned a dramatic diving accident where a diver has died because of a frozen valve in his mouthpiece. The graphic had been designed in two alternative formats to study the effect of the *spatial contiguity principle.* The first format was a traditional *separated* graphic where the main text and the explanatory graphic box are physically far from each other, without any attentional guidance (Figure 1). The second, new format that was created was an *integrated* graphic where the semantically relevant parts of the information graphic were placed physically close to those parts of the main text where the reference had to be made or where an explanation was needed (Chart 1). The two contrasting versions of the information graphic contained the same text and the same illustrations, but had a different overall layout. We hypothesized that a shorter distance between the text and illustration would support the users: The integration of text and graphics would be much easier to make, a split of attention would be avoided, and a deeper semantic processing of the material promoted.

For all participants and both types of graphics, we compared three important measures of online reader behaviour: reading order, reading time, and text/graphic integration. The data clearly show that different spatial layouts have a significant effect on readers' eye movement behaviour. In the separated format, readers do not switch between text and graphics. Instead, they treat them separately as two different units, and almost no integration occurs. In contrast, the *integrated* format with shorter physical distance between text and graphics facilitates integration. It makes it easier for the reader to find the correspondences between referents in the text and in the illustration, and to mentally integrate information from the two different sources. The hypothesis could be confirmed: The *integrated format* with spatial contiguity between text and illustrations facilitates integration.

Figure 2: Dual scripting principle (perceptual and conceptual guidance)
(Source: produced by the authors)

The information graphic concerned the medical issue of catching a cold. This graphic was designed in two alternative formats to test the *dual scripting principle*. The dual scripting principle is associated with a bottom-up guidance through the spatial layout of the presentation, suggesting a specific reading path, and with a top-down guidance through the conceptual pre-processing of the contents, facilitating semantic integration of the material. Format 1 was a traditional radial format (Figure 2) and format 2 was a new, serial format (Figure 3). The *radial* format follows the centre-periphery principle. It consists of a dominant naturalistic picture in the central part of the graphic and a number of smaller components, such as lists of items, renderings with annotations, sequences of depictions, and zooming boxes, all placed in the periphery. The radial format allows the reader to choose between many possible entry points and reading paths. Readers can make their own connections between the components since there is no explicit guidance in the format.

The remodelled, *serial* version of the information graphic has a sequential format with dual attentional guidance. First, we provided a bottom-up guidance through the spatial layout of the presentation by suggesting a specific reading path. Second, we provided a top-down guidance through

the conceptual organization of the contents, facilitating information processing and semantic integration. The different components of the information graphic were grouped into macro-topics in a logical sequence: from introductory information (Why you catch a cold), everyday background knowledge (The usual ways of catching a cold), expert knowledge (What happens in the body) to practical information (How you can alleviate the symptoms). By enhancing the temporal, spatial semantic, and logical arrangement of components, we created an overall coherent presentation that supports the message. We hypothesized that a format that is spatially and conceptually organized and *pre-processed* would guide the readers' navigation and prolong reading.

Figure 3: Serial graphic (above) and radial graphic (below) with prototypical scannpath of one reader.

(Source: produced by the authors)

Reading of information graphics was significantly enhanced by the serial format. Due to dual attentional guidance, the format supports navigation and semantic processing of the contents. This not only has the effect of catching the readers' attention, but also sustains their interest in the material. The readers followed the suggested reading path and the serial graphic was read more than twice as much as the radial graphic—in spite of the fact that the content and the position in the newspaper were exactly the same. Moreover, integrative saccades were almost twice as common in the serial format compared to the radial format. Thus, the hypothesis was confirmed: The *serial* layout that is spatially structured and conceptually preprocessed enhances reading and text/picture integration.

To sum up, the naturalistic reception study confirmed both principles. They seem to be relevant as means of attentional guidance for for example the design of printed and digital media, computer-based instructional materials, and textbook design.

4. Discussion: Different ways of reading

In this concluding section we will discuss the relations between media structures, media design principles and different ways of reading. So far, we have discussed the functionality of modern multimodal media messages: how they are structured and designed, what demands they place on the user, and what effects different designs have on users' meaning-making. Results from a reception study have shown that different designs of multimodal news graphics lead to significant differences in user behaviour, integration of various modes, and comprehension of the material.

In modern society, the presence of visuality and multimodality is a fact that cannot be neglected. Media messages are often fragmented, visual patchworks. It is evident that different designs are associated with different gains and losses. One obvious gain with a more fragmented design without any strong attentional guidances is that it makes the reception more flexible: The reader is free to make choices concerning entry points and reading paths. Media messages can thus be used in different ways and for different purposes. This, of course, has consequences for the process of meaning-making. The user is co-constructing the meaning of the designed composition in the sense that s/he chooses and skips parts of the message accor-

ding to particular preferences and goals. This flexibility is probably inevitable, since many texts in modern society are intended to fulfil several different functions and address a heterogeneous target group (cf. Kress 2005). Also, through a change in literacy, non-intensive reading strategies such as skimming and browsing have become more crucial (cf. Kress/van Leeuwen 1996: 218ff.).

The changes in the media community associated with changes in literacy, widening of audiences and larger diversity of background knowledge and interests give media producers less authority to presuppose what the users need and want to know (cf. Kress 2005). Therefore, it may be necessary to design media messages in a flexible way, enabling the reader to become an active co-constructor of meaning in a particular situation of use. The reception study confirmed this effect: reading is a dynamic process where the same text is consumed in very different ways by different readers, according to their preferences and goals.

The study stressed the user's active, creative role in the interaction with the fragmented text. But it also showed that layout and design have a large effect on the process of reading, meaning-making and comprehension. This calls for reflection. If co-creativeness is a precondition of multimodal design, then it also means that the designer (producer) of the message has partly let go of the control and responsibility for meaning-making. This is because one of the losses of a fragmented design is the fact that interactivity is obligatory in a fragmented structure. If so, the reader is *forced* to be co-constructive in a design where no *right* way of reading is indicated. This leads to a risk of information loss, as the reception study also demonstrated. Such information losses include a risk of atomization of knowledge. After all, a more linear design promotes more complex discussions, explanations and expositions. As the study concluded, users did not integrate graphics and news text when their connectedness was not signalled, and skipped those parts of the message that had a less transparent composition.

This raises a question for modern media design: What is the optimal design for a message to be functionally used in different ways and serve several purposes? How much responsibility for the meaning-making should be placed on the reader? Are there solutions for the design of flexible messages without the possible negative effects of fragmentation?

Finally, the empirical results confirm the hypothesis that both content and structure are of importance (Bucher 2000). Recipients interpret media

messages both on an operational level (regarding the organization of the material) and on a content level (regarding the information, topics and opinions presented in the material). This means that visual design can be used as a resource for the readers' orientation in the text (Lemke 1998). It can guide the reader by structuring functional multimodal units, by suggesting a canonical reading path, by marking an information hierarchy, or by signalling the semantic connectedness between different parts of the fragmented message. In this way, the structure of the message can be made explicit and transparent, but it can still enable the user to choose different entry points and reading paths according to particular goals. Designers must therefore consider the following questions: How is the text intended to be read? In which contexts, for which purposes and by whom? What is crucial for the reader to know? What does the reader *want* to know?

To conclude, producers of media messages cannot neglect the role of visual design and multimodality. The same holds even for media and communication research—if we want to understand the structure and reception of modern media messages, we must take the multimodal approach seriously.

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