Rune Pettersson

Selected Readings

Institutet för infologi

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The picture on the cover shows a section of a foundation to a house in Skultuna, Västmanland, Sweden. The foundation is probably more than 250 years old.

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Contents

Preface

During the past decades I have written more than two hundred "papers" and more than 60 books. Most of my papers include some aspects of communication, design, learning, media development or visual literacy. Like the single stones in a stonewall all these papers help to build a joint structure.

Many of my papers have been presented at international research conferences. Several papers are published in peer reviewed conference proceedings and several papers are published in scholarly journals.

This anthology includes a selection of 25 papers. The complete references to these selected papers are placed at the end of the book (p. 463). In the book several titles are shortened. The papers present various aspects of information design and visual communication. However, since each paper was written for a specific purpose some basic information design sections are included in several papers.

Most conference organisers provide specific guidelines with respect to layout, typography and writing style. In this publication all papers are adopted to one uniform graphic standard.

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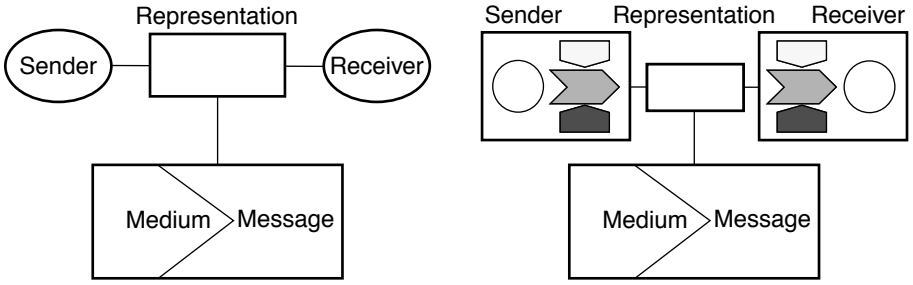
Verbo-visual communication

Communication takes place when a sender conveys a message to a receiver. The sender transfers the message to the receiver with the help of different media. A medium with a specific message is a repre-sentation. All representations are the result of biological, cultural, economical, emotional, historical, political, religious, social, and subject matter factors. All we have got to communicate with are various kinds of representations.



Left: A "representation" is a medium with a specific message.
Right: The sender transfers a message to the receiver with the help of a medium. Several activities are involved when an intended message (left circle) is communicated from a sender to a receiver, and received as an internalized message (right circle). These processes are guided by principles (upper pentagons) and performed with the help of tools (lower pentagons).

In the production of information a sender conveys information on a part of reality via a representation to an information receiver who, via sensory impressions, is able to obtain a perception of that specific part of reality. This perception may then evoke responses that affects reality and creates feedback to the original sender. In this case the receiver becomes a sender, and the sender becomes a receiver. In reality, both the sender and the receiver are involved in several different activities when a message is communicated.

In this model for communication of verbo-visual information the main emphasis is on the sender, and on the production and presentation of information and learning materials. Thus the model does not primarily focus on the receiver's interpretations of and reactions to advertisements, art, entertainment, news, and propaganda.

Combinations of words and visuals

In the late twentieth century technical developments have moved at a very rapid pace. The pace of development is more likely to increase than decrease in the future. Visual messages in different forms will become increasingly important. However, only limited knowledge is available about visual communications, pictures as a means of linguistic communications and the interplay between verbal and visual messages.

Attention should be devoted to issues concerning the production, transmission and perception of messages consisting of verbal (written or oral) and visual presentations (verbo-visual presentations) in all types of media. Since "visual literacy" is a very broad and somewhat confusing concept, and does not include verbal information, Pettersson (1989) coined the term *infology*, and defined it as the presentation and perception of verbo-visual information.

According to Pettersson, infology encompasses studies of the way a verbo-visual representation should be designed to achieve optimum communication between sender and receiver. Like visual literacy, infology is interdisciplinary and encompasses many aspects from established fields such as aesthetics, art, audiovisual media, cinema, computer graphics, computer science, education, film, graphic design, information ergonomics, information science, information technology, information theory, journalism, linguistics, mass communications, media, pedagogics, photography, physiology, psychological information theory, semantic information theory, semiology, sociology, speech communication, television, trade language, visual arts and visual thinking.

The concept *information design* usually concentrates on typography and graphic design of information materials (Tufte 1990). Thus, information design does not cover the same fields as infology.

Infology includes the study of parts of the communications process as well as various types of presentations. Each "part" and each "type" can be divided in several sections.

Communication

Infology, when viewed from a communications perspective, encompasses studies of the way a representation should be designed to achieve optimum communications between the sender and the receiver. Thus, some studies are concentrated on the communications process as such, some on the sender, some on the receiver and some on the representation. As noted in the introduction, a representation is a medium with its specific message. The message has a content as well as an execution. Different media are undergoing comprehensive changes. The representation is always used in a certain context and it has a specific format.

Presentation

Based on how the verbal information is presented to the receivers, three main types of verbo-visual information can be distinguished. The text is *read* in *lexi-visual representations*, such as messages printed in a book or displayed on a computer screen. Speech is *listened* to in *audio-visual representations*, such as in oral presentations with slides or overhead transparencies and in television programs. In *multi-visual representations*, such as interactive multimedia systems, there is a combination of lexi-visual and audio-visual representations.

Information materials often consist of words. There is probably no other instructional device that leads to more consistently beneficial results than adding pictures to a verbal presentation, oral or written. There can be no doubt that pictures combined with words can produce strong facilitative effects on retention and learning. These effects prove to be valid for a broad range of texts, pictures, learner characteristics and learning tasks (Levie & Lentz 1982, Levin & Lesgold 1978, Pettersson 1989, 1993).

Audio-visual representations may consist of "oral presentations" and "recorded representations". In each group there are several ways of combining the verbal and the visual information.

In interactive systems and simulators it is possible to have an active cooperation between lexi-visual and audio-visual representations. In each group there are several ways of combining the verbal and the visual information. It is possible to create the "total information material" and the "total teaching aid" with completely new dimensions (Pettersson 1989, 1993). In this case the information may be digitally stored on an optical disc, such as a CD-I (Compact Disc Interactive).

Characteristics of verbal language

Some characteristics of verbal language, oral and written, are listed with short summary statements, referring to relevant research.

- Verbal languages have digital coding using combinations of letters (and/or numerals) to represent content (Elkind 1975).
- There is no direct correspondence between groups of letters, words and reality. Each meaning is defined and must be learned (Elkind 1975).
- The properties of letters are limited. A letter has a given position in an alphabet, it has a name, it is represented by one or more sounds and is used in a context (Elkind 1975).
- Verbal languages have varying levels of meaning (Eco 1971): (i) phonemes (without meaning); (ii) morphemes (with meaning); (iii) syntagms, submeanings; (iv) complete meanings.

- Semantic codes, grammar and syntax must be defined (exactly) (Chomsky, 1959).
- The perception of linear representations requires a slow and sequential processing for comprehension of content (Perfetti 1977, Sinatra 1986).
- Memory retrieval is a serial integration process and entails sequential processing by auditory-motor perception systems (Sinatra 1986).
- Dissatisfaction with the execution of a message may cause dissatisfaction with the content of the message (Pettersson 1989).

Characteristics of visual language

Some characteristics of visual language are listed below with short summary statements, referring to relevant research.

- Visual languages have analog coding employing combinations of basic graphic elements (dots, lines, areas and volumes) for depicting reality (Pettersson 1989).
- Visual languages attempt equivalence with reality. Visuals are iconic. They normally resemble the thing they represent. Meaning is apparent on a basic level, but the visual language must be learned for true comprehension. There are major differences between the concepts "seeing", "looking" and "reading" (Pettersson 1989).
- Visual languaging abilities develop prior to, and serve as the foundation for, verbal language development (Reynolds-Myers, 1985).
- Development of visual languaging abilities is dependent upon learner interaction with objects, images and body language (Reynolds-Myers 1985).
- Perception of two- or three-dimensional representations entails fast, parallel, simultaneous and holistic processing (Gazzaniga 1967; Sperry 1973, 1982).
- It may take only 2-3 seconds to recognize the content in an image (Paivio 1979; Postman 1979), but 20-30 seconds to read a verbal description of the same image (Lawson 1968; Ekwall 1977) and 60-90 seconds to read it aloud (Sinatra 1986). In verbal and visual languages, prior experience and context are very important to the perception of contents.
- Memory for pictures is superior to memory for words (Paivio 1983). This is called the "pictorial superiority effect."
- Memory for a picture-word combination is superior to memory for words alone or pictures alone (Haber and Myers 1982).

Sender activities

In the production and distribution of a verbo-visual message, the sender will use several processes and production tools. Hopefully, the sender is guided by some solid principles and guidelines.

Generally speaking the sender may be an advertiser, an artist, a business person, an instructor, a subject matter expert, a teacher, a writer, a book publisher, a film producer, a television producer, or anyone else who wants to convey an intended message to one or more receivers.

Intended message

An intended message may *consist of* specific ideas, thoughts, data, information or some subject matter facts. It is always very important for the sender to make two decisions as early as possible:

1. Define the *purpose* of the intended message
2. Define the *receiver* of the intended message
3. Define the type of *representation* for the intended message

The *purpose* of an intended message may be advertising, a business proposal, education, entertainment, information, instruction, learning, training, a change of behaviour, an action of any kind, or any combination of these.

There are many groups of *receivers*. The receiver of an intended message may be business partners, colleagues, dentists, employees, course participants, ministers, students, teachers, veterinary surgeons, retired professors, teenage girls or a "general" audience. It is obvious that a person may belong to several groups of receivers, or target groups. There are always individual differences among members of any group. The sender needs to consider age and gender, and cultural, economical, historical, political, religious, and social factors.

It is also very important to decide on the *type of representation* as early as possible. Lexi-visual, audio-visual, and multi-visual representations are subject to different message design processes. Different types of representations are partly guided by different principles, and different tools are used. However, some principles, and some tools are the same for different representations.

In this paper the main emphasis is on learning. Here, the sender wants a receiver to learn about a specific subject matter. Thus, the sender produces a learning material to be used by the receiver.

The sender's creative processes

The sender's creative processes are influenced by message design principles, and are performed with message design tools. The design principles can be seen

as guidelines for design and development of any verbo-visual message. The sender should:

- Edit the verbo-visual message for better comprehensibility and easier understanding. Editing for a selected target group includes: subject matter depth, structure, clarity, simplicity, consistency and unity.
- Adapt the verbo-visual message to human attention and perception in order to facilitate learning.
- Consider costs.
- Secure quality.
- Respect copyright, ethical rules and media-specific ethical guidelines.

Main creative processes include the following activities:

- Organize the work.
- Analyse the intended message.
- Define the objectives.
- Analyse the receivers. Consider age, gender, and socio-economic factors.
- Consider views and any feedback expressed by receivers.
- Analyse information requirement.
- Select a method for framing of the verbo-visual message.
- Select a suitable medium.
- Produce synopsis: text and pictures.
- Produce draft: text and pictures.
- Produce script: text and pictures.
- Produce originals: text and pictures.
- Revise quality.

Main design tools include:

- Text: printed and spoken
- Symbols
- Pictures: drawings and photos
- Typography and layout
- Sound and sound effects

The sender's production processes

The sender's production processes are influenced by production principles, and are performed with production tools. The production principles can be seen

as guidelines for production of any verbo-visual message. Main production principles include:

- Live media principles
- Sound media principles
- Film media principles
- Broadcast media principles
- Video media principles
- Models and exhibitions principles
- Graphical media principles
- Telecommunications media principles
- Computer media principles

Main production processes include:

- Live media production
- Sound media production
- Film media production
- Broadcast media production
- Video media production
- Models and exhibitions production
- Graphical media production
- Telecommunications media production
- Computer media production
- Quality reviews

Main production tools include:

- Pens, pencils and other materials for manual work
- Computers and software to process texts and images
- Printers, copying machines and printing presses
- Cameras (still, film and video)

The sender's distribution processes

The sender's distribution processes are influenced by distribution principles, and are performed with distribution tools. Main distribution principles include:

- Economy
- Efficiency
- Timing

Main distribution processes include:

- Stock keeping
- Marketing and advertising
- Selling and distribution
- Billing and bookkeeping

Main distribution tools include:

- Warehouses and stores
- Databases, Internet etc

Representation

As noted at the beginning a representation is a medium with a specific content. Representations are used in different presentations:

- Lexi-visual representations
  - Manual productions
  - Technical productions
- Audio-visual representations
  - Oral presentations
  - Recorded representations
- Multi-visual representations
  - Interactive systems
  - Simulator systems

Different media can represent reality with varying facility owing to differences in the structure, in the kind of representation involved, and in the content. There are several areas of interest. Regardless of the purpose, and the intended receiver it is possible to study and analyse the representation with respect to areas like:

- Interplay of words and visuals
- Legibility of text and pictures
- Readability of text and pictures

Main media considerations include:

- Costs
- Credibility
- Mass media and mass communication
- Media and society
- Media characteristics

- Economical, political, and social situation
- Technology trends

Main message considerations include areas such as: advertising, aesthetics, art, business presentations, education, entertainment, factual information, instruction, news, and training.

Receiver activities

In the receiving of a verbo-visual message, the receiver will use several processes and "reception tools". The processes are influenced by reception principles. All receiver processes are influenced by prior experience in relation to age and gender, as well as by cultural, economical, historical, political, religious, and social factors. Such experiences will influence our selection processes, our mental process, and our response processes. The influence of these factors have a major influence on how receivers relate to verbo-visual messages of different kinds, and on how meaning is constructed.

The receiver's selection processes

The receiver's selection processes are influenced by selection principles, and are performed with search and selection tools. Main selection principles include the following areas:

- Available time
- Costs
- Credibility of the sender
- Credibility of the information
- The role of media in society
- Various cultural, economical and social factors
- Ease of use
- Individual interests
- Language
- Needs
- Reading value

Main receiver processes include:

- Search for information
- Selection of information

Main search and selection tools include:

- Indexes, directories, and catalogues
- Computers and databases
- Libraries
- TV sets

The receiver's mental processes

The receiver's mental processes are influenced by attention, perception, and learning principles, and are performed with sensory organs and the nervous system. The interpretation of an intended message will be influenced by the experiences of the individual receiver. In many situations different individuals will interpret the same representation in different ways. Main perception principles include the following areas:

- Attention principles
- Perception principles such as closure, common fate, constancy, context, continuity, contrast, figure and ground, objective set, principle of economy, proximity, and similarity
- Processing principles such as cue theory, fual code model, and schema theory
- Subliminal perception

Main mental processes include:

- Attention
- Perception
- Mental processing
- Application
- Reading
- Intellectual development
- Understanding

In perceiving a verbo-visual message the receiver makes use of sensory organs and the nervous system:

- Sensory organs for feeling, hearing, listening, seeing, smelling, tasting
- The nervous system
- The brain
- Previous experience and knowledge
- Inner images

The receiver's response processes

The receiver's response processes are influenced by response principles, and are performed with response tools. Main response principles include:

- Rules
- Guidelines
- Standards
- Values

Main response processes include:

- Application of knowledge
- Change of behaviour
- Change of emotional status
  - Anger
  - Disgust
  - Fear
  - Happiness
  - Sadness
  - Surprise

In some situations it may be possible for the receivers to provide the sender with feedback. This feedback may be of great value for the sender when updating the information material. However, in many situations it is not at all possible for the individual to give any feedback to the sender. Main response tools include:

- Body language
- Verbal language
- Visual language

The internalized message

When a message is internalized the receiver has got a set of new emotions, new experiences, new feelings, new knowledge or new understanding. The internalized message will influence the interpretation of future messages.

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What is information design?

Abstract. *In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message—its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. Information design is a multi-disciplinary, multi-dimensional and worldwide consideration with influences from areas such as language, art and aesthetics, information, communication, behaviour and cognition, business and law, as well as media production technologies.*

This paper has three main sections. The first section, *Information*, presents definitions of the term *information* and reviews several information disciplines. The second section, *Message design*, presents definitions of the term *design*, and presents various views on *instructional design* and *instructional message design*. The third section, *Information design*, presents several views on *information design*. As a discipline information design has three main areas of knowledge: (1) infography, (2) infology, and (3) infodidactics. Information design encompasses studies of the way a representation should be designed in order to achieve optimum communication between the sender and the receiver.

Information

The term *information* is derived from the Latin noun informatio which means a conception or an idea. Information has therefore long been synonymous with (1) data, details, facts, and intelligence. However, the term information has acquired additional meanings. It may also refer to (2) the import ascribed to specific data. Then information does not arise until the received data, e.g., a text or a picture, are interpreted by the receiver for formation or moulding of the mind. The term information is also sometimes used for (3) data processed in a computer. Yet another meaning (4) is "an internal structure which regulates processes." The latter meaning is used in computer science and in genetics. According to *The new Shorter Oxford English Dictionary on Historical Principles* (Brown, 1993, p. 1364) the term information can also be used for (5) a formal written statement or accusation, (6) the action of informing against a person; and (7) the giving of a form or essential character to something; inspiration.

The verb *inform* means to supply or convey information or to provide knowledge of something and is therefore an unidirectional process, e.g., from one person to another. In my view, to *communicate* entails an interplay between two or more persons. Thus information is a richly varied concept covering many important disciplines and areas of knowledge. Most people are involved with communications and communications systems in one way or another. Some of these systems have soft, human or linguistic dimensions, whereas others possess hard, technological dimensions. Some subject fields have been well-established for many years. Others are relatively new. These fields can be regarded as independent scientific disciplines or branches of learning. In several instances, there is some overlapping because certain sub-issues are addressed in different disciplines, even if the approaches may vary. The main information disciplines are briefly reviewed below (in alphabetical order).

Computer science comprises research on the principles for construction, operation, programming and applications of computers. A special focus is on computer software, and analysis of instructions and information needed to solve formalized problems. Practical applications are seen in the development of various computer-aided systems, such as computer-aided software engineering.

Human computer interaction (HCI) comprises research on the design of computer systems that support people so that they can carry out their activities and tasks productively and safely. Human computer interaction has a role in the design and development of all kinds of man–machine systems. Safety aspects are very important in the design of control systems for air traffic and nuclear plants. High productivity and job satisfaction are important issues in office systems. Entertainment and fun are key concepts in the design of computer games. Interactive information systems are needed in all these cases.

Information economics comprises research on the business development of information industries. There are a lot of information jobs in all kinds of workplaces, and an increasing number of employees are working with information. Other areas of research are the impact of information and communication, the application of information technology in the work-place, the history and geography of information labour and capital, the regulation and provision of information infrastructure, and the use of computers and networks.

Information ergonomics comprises research and development of the ergonomic design of man-machine systems. The design of an information system must be based on studies of the information user's aims, knowledge, experience, and way of working. Tasks making particularly heavy information demands occur in work at computer terminals, work at complex information panels, and in signal systems (e.g., for the monitoring of industrial processes and tools). Information ergonomics include lighting, the design of instrument panels, video display units, characters, symbols, signals, etc.

Information management (IM) comprises research and development of management of information in organisations. Information is divided in small units, sometimes called *information elements*. These elements are linked to objects and can be managed in computer systems, information management systems (IMS). An information element may be e.g., one or more paragraphs of text, a table, or a picture. Sometimes these elements are called *information modules*.

Information processing is a discipline comprising the processing of information so as to yield new or more useful information. Researchers use mathematical and numerical analysis plus methods and techniques for administrative data processing. The discipline also comprises the study of information searches in databases, information systems, computer aided translation, computer aided education, computer aided problem solving, computer aided design, etc. The term information processing is often used as a synonym for data processing, i.e., the execution of a systematic series of operations on data. The term is also sometimes used for studies of the way people process information mentally.

Information retrieval (IR) comprises actions, methods, and procedures for tracing of data and information stored in computers, libraries, etc. in order to provide information on a given subject. Information retrieval is also a part of information science, but is sometimes considered a research area of its own.

Information science, or *library and information science*, is an interdisciplinary area of research. It comprises the study of information in general, and storage of information with sub-areas like classification, indexing, cataloguing, and bibliographic and other databases. Other important areas are seeking, retrieval, and dissemination of information, especially scientific and technical information. Information science also comprises various library information service activities. The main activities include administration, collections, circulation as well as scientific communication, use of information, and information resources management. The task of an *informatic*, i.e., documentalist, is to collect and tabulate scientific information. This information is often sought in national as well as international databases.

Information systems (IS) comprises studies on development, use, and evaluation of computer-based information systems in various kinds of organisations. The social context where these systems are used are important areas of research. Introduction of new information systems usually cause changes in the traditional work processes as well as reorganisation of the administrative routines and organisations.

Information technology (IT) comprises research and development of the technical systems used for making production, distribution, storage, and other information handling more efficient. This includes computer technology and electronics. The term *information society* is sometimes used in information technology. This is a designation for the society which follows after an industrial society and in which man's thinking power is supported by information pro-

cessing computer systems and modern telecommunications techniques. The information society is dominated by the resource information instead of the traditional resources energy, raw materials, labour, and capital.

Information theory is a scientific discipline which comprises quantitative measurement of transmitted information and comparison of various communications systems, especially in telecommunications. In information theory, the information's contents lack inherent interest. Information theory is based on a mathematical theory presented in the 1940s by the American mathematician Claude E. Shannon. It subsequently came to be known as the Shannon and Weaver mathematical communications model. In this kind of communications system, a sender (e.g., a telex unit) communicates with one or more receivers (other telex units) via a channel. The sender codes the transmitted signal, and the receiver decodes the received signal. Information theory utilizes the *bit* as the smallest unit of information. A bit can either be a one or a zero, representing, e.g., yes/no or on/off. The Shannon and Weaver communications theory was originally developed for studies of telecommunications and other technical systems. However, the theory has also been used as a model for communications between people.

*Media and communication*s is a wide area of research. At universities in Sweden media and communication studies take an interest in research on mediated communication, in contrast to research on personal communication which is common in many other countries. Mediated communication comprises the study of the communication processes, including the technical production of media. A few years ago the main focus was on the senders, who wanted to reach out with their messages to large groups of receivers in *mass-communication*. These messages were mainly intended to provide entertainment, information and news, and to some extent also advertising and propaganda. Today it is more common in media and communication studies to focus on the individual receivers, their individual interpretations of the varying messages, and the constructions of meaning made by the receivers.

*Planned communication*s or *persuasive communication*, comprises studies on advertising, propaganda, and other carefully planned information activities. Here the goal is always related to some kind of change in the behaviour of the receivers. Receivers are typically asked to *do* something. Ads may ask people to vote, go to church or stop smoking, and often the intention is to persuade them to buy a special service or a special product. While advertising presents positive images, propaganda often creates negative images. Propaganda reinforces our prejudices and feelings regarding events, groups of people, or products. In order to influence others, the senders must exchange information, accurately transmit their message and intentions, and identify and understand the habits of the receivers.

Psychological information theory is the designation for one of the main branches of cognitive psychology. It refers to the study of man's *mental information processing* of text, pictures and other representations. A major principle in cognitive psychology is that man organizes impressions and knowledge into meaningful units. This process starts with attention and perception. Psychological information theory describes the cognitive processes in the brain as a flow of information between different memory functions.

In philosophy, *semantic information theory* refers to the information supplied by a proposition in terms of the proposition's probability, and specifies the principles for measuring information.

Social information, i.e., the result of all information measures whose aim is to make it easier for citizens to know what their rights, privileges, and obligations are, is studied in social science subjects. Good social information should be readily accessible, tailored to local requirements, readily grasped, adapted to individual needs, and capable of creating a state of preparedness in the receiver. Social information must be closely integrated with the activities of the respective authorities, professionally planned and designed, and disseminated through efficient media.

Message design

In the *The new Shorter Oxford English Dictionary on Historical Principles* (Brown, 1993, p. 1752) the term *message* is defined as: "brief communication transmitted through a messenger or other agency; an oral, written, or recorded communication sent from one person or a group to another." Please note, that it is implied here that the message actually is *received* by the receivers. And the general meaning of *design* is defined (p. 645) as: "plan and execute (a structure, work of art, etc.); fashion, shape; make a preliminary sketch for (a work of art, etc.); make drawings and plans for the construction of production of (a building, machine, garment, etc.)."

People have been designing, planning and executing messages in all times. Design and presentation of messages, as well as perception and cognition of messages, are activities that some of the different research fields within information and communication have in common. In this section the focus is on *instruction*, and thus on presentations and on messages intended for learning.

Instructional design

With roots in the use of audiovisual media in teaching and research on *educational technology*, the term *instructional technology* was introduced in the 1960s. For the first 25 years the name of the scholarly journal published by the *Asso-*

ciation for Educational Communications and Technology (AECT) was *AV Communication Review*. In 1978 the title of the journal was changed to *Educational Communications and Technology — A Journal of Theory, Research, and Development* (ECTJ). In 1989, *ECTJ* and the *Journal of Instructional Development* (JID) were consolidated and merged into *Educational Technology Research, and Development* (ETR&D). It is since the main publication of the AECT. According to Dijkstra, van Hout Wolters, and van der Sijde (1990) the term *instructional technology* was introduced in order to give a description of methods and procedures of instruction used to promote the acquisition of knowledge and cognitive skills, mainly in classrooms and other formal learning situations. Heinich, Molenda, and Russell (1982, p. 19) defined *technology of instruction* as: "the application of our scientific knowledge about human learning to the practical tasks of teaching and learning."

In 1974 Gagné and Briggs introduced the term *instructional design*. They showed the influence of cognitive psychology on the description of different types of learning, and on the analysis of the learning task. Glaser (1978) showed that the study of acquisition of complex human behaviours in formal instructional settings will contribute both (1) to the theory of knowledge acquisition within the science of cognition, and (2) to the technology of instruction. Later Briggs and Wager (1989) published a handbook of the procedures for the design of instruction. Here the central focus is on the *design of instructional materials*, whether print or non-print. Thus the book is mainly written for those instructors who want to learn how to: "develop predesigned, *materials-centered* instruction, as distinct from *teacher-centered* instruction" (p. v).

According to Fleming and Levie (1993, p. x) Reigeluth (1983) defined *instructional design* as "the process of deciding what methods of instruction are best for bringing about desired changes in student knowledge and skills for a specific course content and a specific student population." Later Reigeluth (1987) applied the appropriate models and theories to the design of lessons. And in 1993 Wileman (p. 112) defined instructional design as "the process of planning lessons based on learning objectives." Reigeluth (1983, 1987) defined three types of main variables in instructional design. These variables are (1) methods, (2) outcomes, and (3) conditions. Thus, when a designer shall solve an instructional problem, he or she will use the available knowledge about the system and the conditions at hand, and vary the method variables in such a way and toward such values that the desired outcome is achieved.

Instructional message design

In 1982 Heinich et al. (p. 9) defined the term *instruction* as: "Deliberate arrangement of experience(s) to help a learner achieve a desirable change in performance; the management of learning, which in education and training is pri-

marily the function of the instructor." And in 1990 Warries (p. 3) defined instruction as: "Bringing about by means of a well-defined method, that, under given conditions, a learner within a system, will reach a predefined goal."

Fleming and Levie (1978) specified that the term *instructional message design* refers to the process of manipulating, or planning for the manipulation of, a pattern of signs and symbols that may provide the conditions for learning. It is assumed that practitioners in this domain can be more effective if they make use of appropriate generalized research findings from the behavioural sciences. Here the term instruction refer as well to classroom contexts as to more informal contexts where attitudes, concepts, and skills are communicated. According to Fleming and Levie (1993, p. x): "A "message" is a pattern of signs (words, pictures, gestures) produced for the purpose of modifying the psychomotor, cognitive, or affective behaviour of one or more persons. The term does not imply any particular medium or vehicle of instruction." In principle the term message is valid for all media. And *design* (op. cit.): "refers to a deliberate process of analysis and synthesis that begins with an instructional problem and concludes with a concrete plan or blueprint for a solution." The influence of cognitive psychology on instructional message design were further developed by Gagné, Briggs and Wager (1988), and by (Dijkstra et al. 1990).

Instructional design theories provide principles for the design of instruction. In a few cases they intend also to provide teachers with prescriptions. During the last two decades design models and theories of instruction have become important for the work of professional instructional designers. Although design theories frequently refer to descriptive theory and propositions, their main function is to guide the designers on how to design and how to produce courses and lessons.

The *International Visual Literacy Association* (IVLA) was established in 1968 to provide a multidisciplinary forum for the exploration, presentation and discussion of all aspects of visual communication and their applications through the concept of visual languaging, visual literacy, and literacies in general. The *Journal of Visual Literacy* (JVL) is the official scholarly journal of IVLA for presentation of theory and research in this area. For the first seven and a half years the title of the journal was *Journal of Visual Verbal Languaging* (JVVL).

We can note a paradigm shift from the old an d traditional focus on teaching to a focus on learning. In summary, the main function of *instructional technology, instructional design* as well as of *instructional message design* is to guide the professional designers on how to design and how to produce courses and lessons *intended for learning*. There seem to be no major difference between these areas. And they are all closely related to *information design*. The instructional areas are, however, more narrow than information design.

Information design

Information studies as well as media and communication studies are broad research areas with connections to several other areas of research. Many studies have mainly dealt with various aspects of verbal information in different media. Quite often the pictures and images in the messages have been overlooked and forgotten. In many cases researchers have dealt with many aspects of the text but not at all with the pictures.

In the 1950s and 1960s Lidman and Lund (1972) described the advantages with an *informative layout* where text, pictures and graphic design work together to form a message that is easy for the reader to receive and understand. They called this the *third language* as well as *lexi-visual layout*. In contrast to the traditional *artistic layout*, which may please the individual artistic graphic designer, but which has no relation to the content of the message. An informative layout has a *practical purpose*. The lexi-visual narrator was encouraged by Lidman and Lund to consider three important aspects: (1) the theme of the content, (2) the pedagogical purpose, and (3) the aesthetic form. Lexi-visual products are the result of teamwork between subject matter experts, visualizers and editors. The lexi-visual layout was used in the production of visualized encyclopedias for a general market.

Tufte (1990) noted that the term *information design* (ID) has often been used for aesthetic graphic design of information materials. However, Easterby and Zwaga (1984) had provided a wider view of information design when they edited the proceedings from the *NATO Conference on Visual Presentation of Information* in 1978. In the preface to the book *Information Design* (p. xxi–xxii) they wrote: "information presentation involves a wide range of professional interest groups concerned with its development and use; graphic designers, industrial designers and typographers are primarily concerned with design but will acknowledge the importance of evaluation; psychologists and ergonomists have an interest in evaluating the effectiveness of displayed information and some, but not all, will acknowledge the importance of graphic design; architects, planners and engineers have a professional interest in using information as a component in the artefacts they create for society—buildings, roads, industrial machinery and consumer products—but many may not be prepared to acknowledge the importance of design and evaluation of such information. The problem that arises is that each of these professionals approaches information display from a different standpoint—aesthetic, empirical, evaluative, quantitative, pragmatic, practical—and also to differing degrees, depending on the relative importance that these aspects have in relation to their own professional interest and obligations."

In 1979 the *Information Design Journal* (IDJ) started. According to Waller (IDA, 1997) IDJ was intended to be a counterpoint to the corporate identity and

glitzy graphics that seemed to take over graphic design in the 1980s. From the beginning IDJ used a distinctive meaning for the term *information design*: "to apply processes of design (that is, planning) to the communication of information (its content and language as well as its form)." With reference to the display of quantitative information Tufte (1983, p. 87) noted that graphical competence demands three quite varying skills: "the substantive, statistical, and artistic. Yet most graphical work today, particularly in news publications, is under the direction of but a single expertise—the artistic. Allowing artist-illustrators to control the design and content of statistical graphics is almost like allowing typographers to control the content, style, and editing of prose. Substantive and quantitative expertise must also participate in the design of data graphics, at least if statistical integrity and graphical sophistication are to be achieved." It should be noted that that this statement was made in 1983. Today, the situation may be different.

A search on the WWW (in January 1998) for the term information design gave more than 6,500 hits. These hits indicated that the term now is used for a wider concept than graphic design of information materials. Now the focus seems to be on functional verbo-visual communication rather than on aesthetics alone. In the age of information we have an ever increasing need for computer interfaces, educational materials, exhibitions, forms, graphic symbols, instructional materials, learning materials, lists, maintenance information, manuals, non-fiction books, on-line help for managing computer-based systems, procedural aids, product descriptions, public information signs, reference books, road traffic signs, system descriptions, tables, technical reports, tickets, webpages, and other kinds of information materials. These are examples of *information utility goods* that we need to perform our tasks at work. We also need an increasing amount of information materials during our leisure time, in order to be able to handle things like new cameras, cars, CD-players, computers, computer software, etc. *Thus a well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources.*

However, in the future we will focus more on the *information content* rather than on the traditional *information materials* as such. We may need access to the information required for maintenance of a machine, not necessarily for a printed document with this information. Thus many traditional printed documents will be replaced by on-line services. This is a paradigm shift.

Marsh (1983) discussed the term *communication design* for "messages that work". He made a clear distinction between an *artistic approach* and a *design approach*. These two approaches differ in their goals. Marsh commented that the artistic approach strives for *perfection*, while the design approach strives for *workability* in a cost effective context. The design approach minimizes the need for rewriting and editing by careful planning of the work. The two approaches result in vastly different final products. The artistic approach tends to judge suc-

cess by whether the product feels right and whether the critics like it or not. The design approach judge its success by whether the product achieves the objectives as specified by measurable performance objectives, within the specified resources and situational constraints. And the School of Design at Carnegie Mellon University (1997) has defined communication design "as the effective presentation of ideas and information by means of type and image, whether in the traditional medium of print or in the new digital medium that supports interactive computer displays, multimedia communication technology, and information systems". Also here the focus is on *workability*.

Wileman (1993, p. 6) noted that: "Communication can be judged successful only when it conveys the information it sets out to convey. This is as true for visual modes as it is for verbal modes." Also Brandt (1997) provided a practical, workability and useability view related to information utility goods, and defined information design as "the ability to search for information, make choices, create and package information." He further remarked that "the message must reach the receivers in a proper way." A well designed information product will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. Mullet and Sano (1995, p. 2) remarked that: "The goal of communication-oriented design is to develop a message that can be accurately transmitted and correctly interpreted, and which will produce the desired behavioural outcome after it has been understood by its recipient." Pettersson (1996, 1997) provided a process-oriented workability and usability view of communication, and discussed message design principles as well as message design tools.

On its WWW-homepage the *International Institute for Information Design* (IIID) defines design in the following way (1997): "Design is the identifying of a problem and the intellectual creative effort of an originator, manifesting itself in drawings or plans which include schemes and specifications." And information design: "Information design is the defining, planning, and shaping of the contents of a message and the environments it is presented in with the intention of achieving particular objectives in relation to the needs of users. At this point of the development IIID is concerned with the design of visual information but it could in the future include the design of information other than visual one." These two definitions were recommended by the 2nd IIID Conference in 1994. They are also published in several issues of the *ID News*. The main concern of the IIID is to contribute to a better understanding within the human community with respect to cultural and economic issues by means of improved visual communication. IIID is supported by UNESCO (1995), and endeavours to develop information design as an independent interdisciplinary field of knowledge and professional activities.

Thus information design is indeed an interdisciplinary field of knowledge, and as far as I have been able to find out it encompasses influences and facts

from more than fifty established disciplines and areas of research. In this paper the main areas of research are divided into the following six groups. (See Figure 1.) It should, however, be noted that also other groupings are possible.

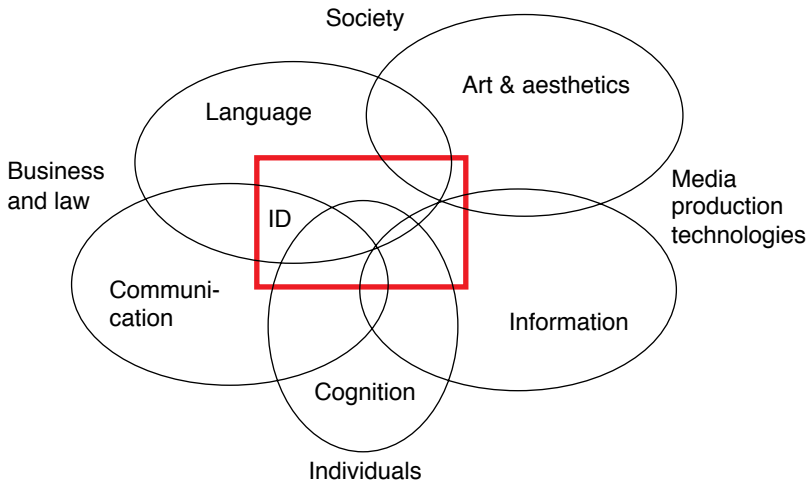

Figure 1. Information design is interdisciplinary and encompasses influences and facts from more than fifty established areas of research. In this theoretical model, main areas in information design (represented by a rectangle, ID) are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.

1. *Language disciplines* such as drama, graphic design, linguistics, rhetoric, semiology, verbal languages, and visual languages. (Graphic design is often seen as an art subject. However, from an information design perspective the language aspects of graphic design are more important than the art aspects.)
2. *Art and aesthetic disciplines* such as aesthetics, computer graphics, film and cinema, illustration, photography, television and video.
3. *Information disciplines* such as computer science, information processing, and information science.
4. *Communication disciplines* such as communication theory, information technology, information theory, media studies, instructional technology, instructional design, instructional message design, journalism, and planned communication.
5. *Behavioural and cognitive disciplines* such as cognitive science, didactics, information ergonomics, pedagogy, psychology, sociology and their sub-

areas. The study of attention, perception, cognitive skills, and memory are especially important. Some aspects deal with individuals, and some with the societies in which we live.

6. *Business and media production technology disciplines* such as business economics and management, information economics, information management, law, and various technologies for production and distribution of different media.

Thus information design does not primarily include areas like advertising, entertainment, fine arts, news or propaganda. Tufte (1990) noted that the principles of information design are universal, and are not tied to unique features of a particular language or culture. And IIID (op. cit.) noted that: "Special attention is paid to the potential of graphic information design to overcome both social and language barriers".

In summary, the study of information design is a multi-disciplinary, a multi-dimensional and a worldwide consideration. We can view and describe information design from various perspectives, or research angles. In my view the four most prominent perspectives are:

1. Areas of knowledge
2. Parts of communication
3. Types of presentation
4. Information contexts

Areas of knowledge

As previously noted the concept of information design is more wide-embracing than the concepts of instructional design and instructional message design. Thus from a cognitive point of view, information design is less demanding than instructional design and instructional message design. In instructional design and instructional message design the receiver shall (usually) *learn* from the message. However, in information design the receiver shall be able to *understand* the message in order to use the information in a practical situation. In many situations this will, of course, also result in learning. But this is usually not required.

Like architecture, dance, fine arts, music and theatre, also information design has a practical as well as a theoretical component. Like the two faces of a coin, *infography* and *infology* are two main parts of information design. As a discipline and an academic subject matter information design has three main areas of knowledge: (1) infography, (2) infology, and (3) infodidactics.

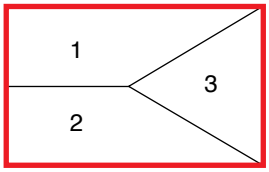

Figure 2. Information design has three main areas of knowledge: (1) infography, (2) infology, and (3) infodidactics.

Infography

Infography is the actual, practical formation and execution of structured combinations of text, pictures, and graphic design (Pettersson; 1989, 1993). The term was initially used mainly for information graphics in newspapers and television, but have later been used in a wider perspective for formation and execution of all kinds of verbo-visual messages used for the presentation of information in all media. The goal is to achieve excellent design skills. An *information designer* (or infographer) needs to have skills in writing comprehensible, clear and consistent texts, in creating clear illustrations, and in creating a clear, transparent typography and layout that aids understanding and learning (Pettersson, 1997). The legibility of a graphical message is determined by the design of its text and pictures, as well as by their clarity. Usually a team of people with skills in the different areas are working together. The task is usually too overwhelming for a single person.

Art is valued for its originality and expressiveness. Its focus is on individual artifacts crafted through the manual and aesthetic virtuosity of the artist. Design, in contrast, is valued for its fitness to a particular user and to a particular task. Of course many designers may want to provide aesthetic experiences where possible, but the design aesthetic is always related to the intended function of the information products intended for widespread distribution and use.

Infology

Infology is the science of verbo-visual presentation of information. On the basis of man's prerequisites, infology encompasses studies of the way a verbo-visual representation should be designed in order to achieve optimum communications between sender and receiver (Pettersson, 1989, 1993). Infology models contain both theoretical (descriptive) elements and normative (prescriptive) elements.

Producers of information and learning materials can facilitate communication, and the learning processes of the readers. Complicated language, in both texts and pictures, will impair the understanding of the message. Active voice, clarity, comprehensibility, consistency, legibility, precision, readability, reading value, simplicity, and structure are the key concepts in information design. Any

graphical message shall be legible, readable, and well worth reading for the intended audience. Any audial message shall be audible, distinct, and well worth listening to for the intended audience. The goal in information design should be *clarity of communication* (Pettersson, 1997).

Infodidactics

Infodidactics is the methods used for teaching the various aspects of information design. The huge spread among the different disciplines makes information design an interesting, but also a complex area of research and teaching. The goal of all scientific enterprise is understanding. When we understand a subject matter we are able to explain phenomena and predict new phenomena. Although information design theories frequently refer to descriptive theory and propositions, their main function is to guide the information designers how to actually design, present and produce information. In order to do this, it is important to work with problem-oriented learning in realistic projects; with existing and true information problems, with regular senders, with actual information materials, and with real receivers that need the information. This also provides realistic experience with budget and time limits.

Parts of communication

Information design encompasses studies of the way a representation should be designed in order to achieve optimum communication between the sender and the receiver. Thus, some studies are concentrated on (1) the communications processes as such, some on (2) the sender, some on (3) the representation, and some on (4) the receiver.

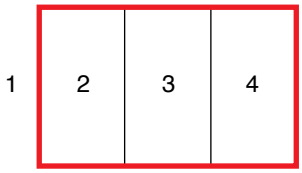

Figure 3. In information design some studies are concentrated on (1) the communications processes as such (the whole ID-rectangle), some on (2) the sender, some on (3) the representation, and some on (4) the receiver.

The communications processes

In the information society, people are being exposed to an increasing volume of messages from many different senders. The messages are transmitted from senders to receivers with the aid of different media. In all communications (even in mass communication), many *individuals* are the recipients of the messages. Both texts and pictures can be interpreted in many different ways. As far as com-

munication of information is concerned, text, and pictures should therefore convey the same message/contents so as to reduce the number of potential interpretations and increase the learning effect. Captions are needed to tie down one of many possible interpretations of pictures.

The sender
The production of a message commences with an idea occurring to someone or with the need to convey information to an intended audience. When an outline is ready, then the generation of text, draft sketches, editing, graphical design, the production of originals, masters, and, ultimately, a given quantity will begin. The sender produces a representation of reality. Other tasks for the sender are stock-keeping, distribution, marketing, advertising, selling, billing, book-keeping, etc. A message with a given form is conveyed by the sender to the receiver with the aid of a medium. Today various media are undergoing comprehensive (technical) changes, changes in terms of production, duplication, stock-keeping, distribution, and presentation of messages. Some of these developments are proceeding in the same direction and working together. Others are on separate paths. Some are even counteracting one another. In information design the task of the sender is actually not completed until the receivers have received and understood the intended message.

The representation
This second part includes three areas of activities: analysing a verbo-visual message, studying the relationships of the message, and studying the development of new media. There are several different research questions at issue within each of these areas.

The receiver
The receiver's perception of a given message is not likely to coincide with the sender's perception of, or intention for a given message. A number of studies have shown that there is a considerable difference between intended and perceived messages. In one instance, the differences amounted to 22 units when a scale ranging from 0 to 100 was used (Pettersson, 1985).

Types of presentation

A verbo-visual representation can be designed in different ways. Based on how the verbal information is presented to the receivers, we can distinguish three main types of verbo-visual representations (Pettersson, 1989, 1993).

1. We *read* the printed words in *lexi-visual representations*, such as messages printed in a book or messages displayed on a computer screen.

2. We *listen* to the spoken words in *audio-visual representations*, such as oral presentations with slides or overhead transparencies and in television programmes.
3. We *read* printed words and *listen* to spoken words in a combination of lexi-visual and audio-visual representations in *multi-visual representations*, such as interactive multimedia systems.

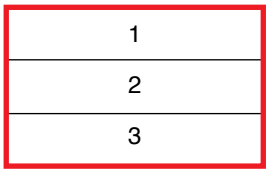

Figure 4. In information design some studies are concentrated on (1) lexi-visual representations, some on (2) audio-visual representations, and some on (3) multi-visual representations.

Lexi-visual representations
Information materials often consist of text. Probably no other instructional device leads to more consistently beneficial results than does adding pictures to a text. There can be no doubt that pictures combined with texts can produce strong facilitative effects on retention and learning. These effects prove to be valid for a broad range of texts, pictures, learner characteristics, and learning tasks (Levie and Lentz, 1982; Levin and Lesgold, 1978; Pettersson, 1989). Lexi-visual representations can be manually produced, "manual productions," or manufactured graphical media, "technical productions." In each group there are several ways of combining the verbal and the visual information.

Audio-visual representations
Audio-visual representations may consist of oral presentations and recorded representations. In each group there are several ways of combining the verbal and the visual information.

Multi-visual representations
In interactive systems and simulator systems it is possible to have an active cooperation between lexi-visual and audio-visual representations. In each group there are several ways of combining the verbal and the visual information. It is possible to create the total information material and the total teaching aid with completely new dimensions (Pettersson, 1989).

Information contexts

A verbo-visual message has both internal and external contexts. Factors inside the medium provide (1) the *internal context*. When we read a book or view projected images the lighting in the room may exemplify (2) the *close context*. The entire communications situation, i.e., senders and their intentions for the verbo-visual message, and receivers and their circumstances provide (3) the *social context*. The close context and the social context are both external contexts.

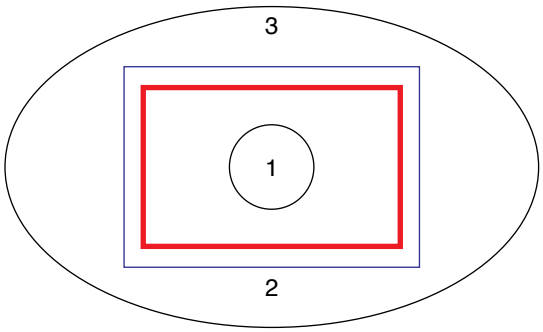

Figure 5. In information design some studies are concentrated on (1) the internal context, some on (2) the close context, and some on (3) the social context.

The context in which a visual message is presented has a major impact on the way the message is perceived. For example, the internal context may consist of text, speech, music, sound effects, or other visuals. Our attention is on either the sound or on the image when we view a film or a TV program. This is even more obvious when we look at a multi-image slide and film presentation. As soon as the film starts, our attention is directed towards the movement in the film, away from the surrounding stills. It is almost impossible for viewers not to be influenced by the film. Our perception of a stimulus is thus not only determined by the characteristics of the main stimulus but also by those provided by the context.

Conclusions

Information is a richly varied concept covering many areas of knowledge. Most people are involved with communications and communications systems in one way or another.

There is no major difference between *instructional technology, instructional design* and *instructional message design*. Here the main function is to guide the professional designers on how to design and how to produce courses and lessons intended for learning. The instructional areas are more narrow than infor-

mation design. There is no major difference between *communication design* and *information design.*

In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message—its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. Information design is a multi-disciplinary, multi-dimensional and worldwide consideration with influences from areas such as language, art and aesthetics, information, communication, behaviour and cognition, business and law, as well as media production technologies. A well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources.

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Objectives

Abstract. *After a short introduction this paper deals with "The objectives dimension in message design". Various areas of design have different objectives, and the materials and products reach out to different groups of receivers. Message objectives diagrams may be used to map various information sets.*

In the design of messages, information materials, information sets, or representations the designer makes certain information available for different groups of people. An information set may be a book, a paper, a poster, a symbol on a signpost, a web-page, and many other products. In each case the designer may have clear intentions and objectives with the information content. However, it is always up to the individual interpreter to conceive or misconceive the available information, to use or not use it, to use or misuse it.

- In *graphic design* the main intentions are to provide functional, aesthetic, and organised structure to all kinds of information sets. The interpreter/s may develop new views, relaxation, emotions, awareness, attention, and understanding.
- In *persuasive design* the main intentions are to provide advertising or propaganda in order to persuade interpreters to buy a product or a service, or to change behaviour. The interpreter/s may develop new prejudices, apprehensions, willingness to buy, beliefs, reinforced attitudes, emotions, opinions, and views.
- In *mass design* the main intentions are to provide news, views, and entertainment. The interpreter/s may develop views, relaxation, emotions, and awareness.
- In *information design* the main intentions are to provide information materials needed by the interpreter in order to perform a specific task. The interpreter/s may develop new skills, understanding, and experience.
- In *instruction design* the main intentions are to provide courses and learning materials needed by the interpreter in order to modify behaviour with respect to learning. The interpreter/s may develop new understanding, experience, comprehension, knowledge, insight, and finally wisdom.

Verbovisual communication

Many information and communication theorists have devised models to explain the way the communication process or processes operates. As early as 1948 Lasswell put it this way: communication are *who* says *what* to *whom* via which *channel* and to what *effect*. Then Shannon and Weaver (1949) proposed a mathematical communications model, which illustrates the way a signal is passed from a sender to a receiver. The model was originally developed for studies of technical systems. However, the model has been used frequently for discussions about human communication (Figure 1).

Figure 1. The traditional view is that communication takes place when a sender conveys one or more messages to one or more receivers. Here focus is on the sender and on the receiver.

Traditional communication models are directional and process-oriented. However, Hall (1980) developed the encoding – decoding model. Here the sender is an *encoder* constructing "meaningful" texts, such as a television program or an information material. The receiver is a *decoder,* and is assumed to accept, negotiate or oppose the intended meaning. Hall emphazied the paradigm shift to earlier traditions.

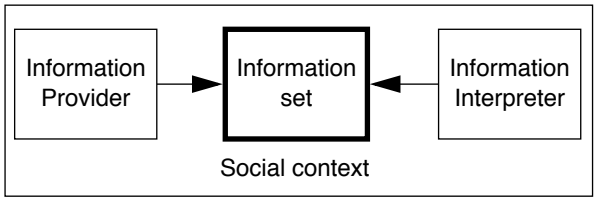


Figure 2. An information set model. An information provider makes one or more information sets available for people who need the information, information interpretors. Here the focus is on the information set.

During the 1990s there has been a change in reception analysis from a focus on interpretation and decoding to a greater concern with practice and use (Hagen, 1998). This development has been described as a change from decoding to viewing context (Morley, 1992). We can see the sender as an "information provider". In each case the sender or the designer may have clear intentions and objectives (Figure 2). However, it is up to the individual "information interpreter" to actively conceive or misconceive the information, to use or not use

it, to use or misuse it. This view is specially valid for information sets that people make available to an unknown audience, e.g. on the Internet and the WWW. Here it is usually not possible to know much about the people who search for, and use the information.

Design of information sets

There are many kinds of information materials in modern society. We may see information sets in most areas of human activities. Here are some important categories of information sets.

1. Administrative information
2. Consumer information
3. Economical information
4. Geographical information
5. Information on goods and products
6. Information on pharmaceutical preparations and drugs
7. Social information
8. Technical information
9. Tourist information

Different media may be used to carry and hold the information content in any information set. Here are some examples:

1. Signs, information signs, sign-posts
2. Posters, information sheets, booklets, brochures
3. Catalogues, manuals, non-fiction books
4. Package, wrapping
5. Sound tape, CD-records, radio
6. AV-materials, slides, OH-transparencies
7. film, video, TV
8. WWW-home pages
9. Exhibitions

Different skills and experiences may be needed in order to produce information sets that work. There are several academic disciplines that may contribute with data and information that is useful for the designer. To some extent "information set design", or "message design" disciplines are similar. However, there are also some important differences between them.

An information design model

Information design can be hard to define, and often goes by other names. In my view (Pettersson, 1998a, 1998b, 1998c, 1998d) information design may be defined in the following way: *"In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message – its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements."*

Information design is an interdisciplinary field of knowledge. It encompasses influences and facts from more than fifty established disciplines and areas of research. The main areas of research may be divided into the following six groups with "base disciplines". However, also other groupings are possible.

1. **Language disciplines** such as drama, graphic design, linguistics, rhetoric, semiology, verbal languages, and visual languages. (Graphic design is often seen as an art subject. However, from an information design perspective the language aspects of graphic design are more important than the art aspects.)
2. **Art and aesthetic disciplines** such as aesthetics, computer graphics, film and cinema, illustration, photography, television and video.
3. **Information disciplines** such as computer science, information processing, and information science.
4. **Communication disciplines** such as communication theory, education technology, information technology, information theory, media studies, instructional technology, instructional design, instructional message design, journalism, and planned communication.
5. **Behavioural and cognitive disciplines** such as cognitive science, didactics, information ergonomics, pedagogy, psychology, sociology and their subareas. The study of attention, perception, cognitive skills, and memory are especially important. Some aspects deal with individuals, and some with the societies in which we live.
6. **Business and media production technology disciplines** such as business economics and management, information economics, information management, law, and various technologies for production and distribution of different media.

Thus information design does not primarily include areas like advertising, entertainment, fine arts, news or propaganda. There are several ways of showing the relationships between the six groups with base disciplines. The "information design model" (Figure 3) is a theoretical model showing that different disciplines *influence* and *contribute* to the area of information design, ID.

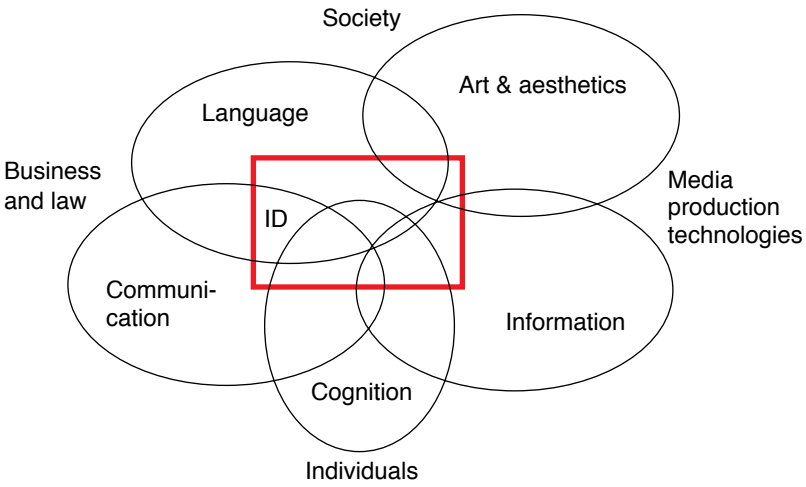


Figure 3. The information design model. The "base disciplines" influence and contribute to information design, ID. Language disciplines are more important to information design than art, information, cognition and communication.

Please note that the ovals in the illustration, representing the various groups of disciplines are not ment to be sharp and distinct. The borders between the areas are rather blurred, unclear, and indistinct. Furthermore, the model is not intended to show any *exact* relationships between the different groups of the base disciplines.

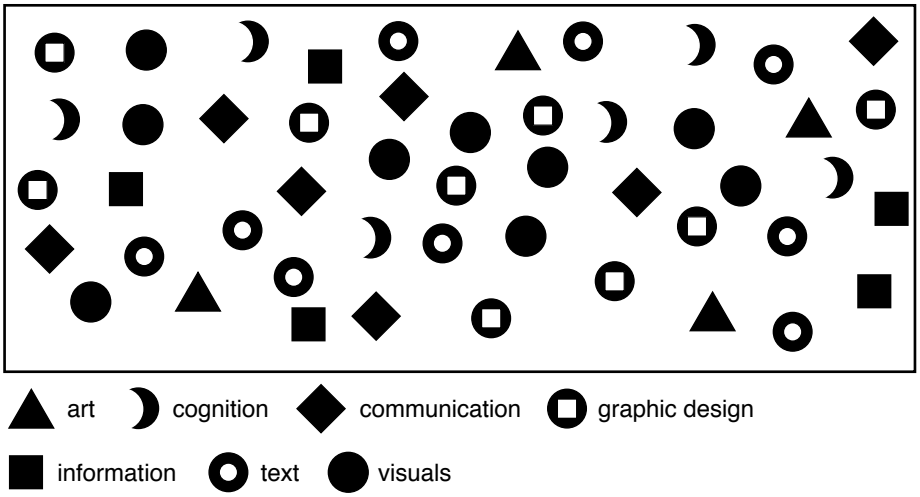


Figure 4. Basic courses in information design include aspects of verbal language, visual language, graphic design, art and aesthetics, information, behavioural and cognitive disciplines and communication diciplines.

It should be possible to recognise the structure in the model if we look at the courses that universities offer in Information Design. Obviously, this is true for our own courses (Figure 4). It will be interesting to look at corresponding curricula from other universities.

Working closely with the information design model presented above (Figure 3) have revealed that it may be used to explain and describe also other interdisciplinary areas of knowledge, such as *persuasion design*, and *instruction design*.

Related message design areas

Information design students were asked to evaluate any perceived differences in the influence of individual groups of disciplines on persuasion design and instruction design, in comparison with information design. For each group of disciplines the students had to judge if the influence was less, equal, or more important to persuasion design than to information design; and less, equal, or more important to instruction design than to information design. The information design model (Figure 3) was used in both cases.

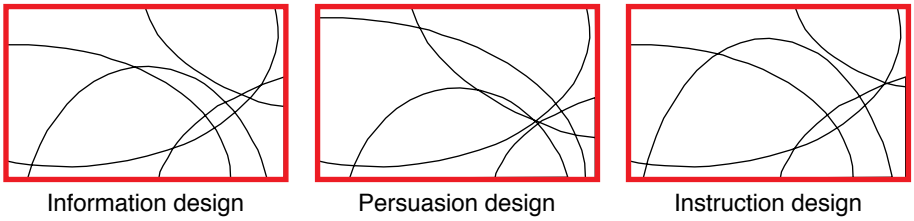


Figure 5. As indicated in these three diagrams the importance of the groups of base disciplines are partly different for information design, persuasion design, and instruction design.

Most students felt that language disciplines are of equal, and large importance for these three design areas (Figure 5). Art and aesthetics disciplines, however, were felt to be more important to persuasion design, but less important to instruction design. Information disciplines were evaluated as less important to persuasion design, and equal or less important to instruction design. Communication disciplines were evaluated as more important to persuasion design, and of equal importance to instruction design.

For instruction design opinions about this variable were the most scattered. One possible explanation for this spread may be a lack of understanding of the subject instruction design among the students. This view is substantiated by the fact that also the opinions about the importance of the other subjects on instruction design are less distinct in their distribution than for persuasion design. Behavioural and cognitive disciplines were evaluated as less important to persuasion design, but as equal or more important to instruction design. It

is obvious that student subjects evaluated a difference in importance of the "base disciplines". This might be explained with differences in intentions and objectives between the three design areas.

Different performance objectives

Several researchers have pointed out that it is important to define clear objectives in message design (Heinich et al., 1982; Marsh, 1983; Fleming and Levie, 1993; and Wileman, 1993), as well as in information design (Mullet and Sano, 1995; and Pettersson, 1998c, 1998d).

A performance, and a change in behaviour, must be *observable*. Thus subjective objectives defined by verbs like *appreciate, assess, describe, discuss, evaluate, know, outline,* and *understand* should be avoided. A statement of design objectives should include the conditions under which the required performance is to be observed and measured, when such conditions are relevant. *Time* and *accuracy* are often meaningful dimensions in assessment of objectives.

Graphic design objectives

Traditional graphic design is a kind of "all purpose-design" used in the production of various media. A generally accepted view is that graphic design may be described as the art and craft of bringing a functional, aesthetic, and organised structure to groups of diverse elements. These elements may be headings, texts, pictures, captions, and tables. Graphic design is used in other, more specialised areas, where the intentions and objectives with the designs vary. Pettersson (1999) noted that *graphic design* includes typography, layout, visual graphic design, and parts of architecture and industrial design. In graphic design the main objective is to provide functional, aesthetic, and organised structure to all kinds of information sets. Here, the information interpreter might be seen as a "reader".

In graphic design it may be an advantage to use verbs like *find, identify, read,* and *recognise.* These verbs all denote observable behaviour. A few examples of performance objectives in graphic design may be:

- *For a table:* 100% of the users should be able to *find* the time for departure of the train to x.
- *For a package:* 100% of the buyers should be able to *read* the text on the package without any difficulty.
- *For a non-fiction book:* 100% of the readers should be able to *read* the text in the book without any difficulty.

- *For a logotype:* 60% of the readers should be able to *identify* a new logotype within six weeks.

Of course the actual numbers, with respect to percent and allowed time, have to be decided in each specific case.

Mass design objectives

Mass design includes aspects from communication studies, mass-communication, media studies, and journalism. Here the main intentions are to provide news, views, and entertainment. The information interpreter might be seen as a "relaxer".

In mass design it may be an advantage to use verbs like *feel, laugh, look, read,* and *relax*. These verbs all denote observable behaviour. A few examples of performance objectives in graphic design may be:

- *For a magazine:* 100% of the readers should be able to *read* the text in the magazine without any difficulty.
- *For news on television:* 70% of the subscribers should *look* at the program at least once every day.
- *For entertainment on television:* 80% of the viewers should have fun and *laugh* at the jokes.

The actual numbers, with respect to percent and allowed time, have to be decided in each specific case.

Persuasion design objectives

In persuasion design the main objective is to persuade the receiver, or rather the "interpreter of the message," to buy a product or a service, or to change his or her behaviour. Persuasive design includes knowledge areas like advertising, propaganda, planned communication and persuasive communication. The information interpreter might be seen as a "possible buyer", a "prospect".

In persuasive design it may be an advantage to use verbs like *appreciate, believe, buy, change (behaviour), desire, dread, fear, feel (relaxed), hate, and have (fun)* in the writing of persuasion design objectives. These verbs all denote observable behaviour. A few examples of performance objectives in persuasion design may be:

- *For a warning:* 90% of the viewers should *change* their behaviour when they have seen the information once.
- *For a new product:* 75% of the viewers should *desire* their own sample of the product when they have seen the information twice.

- *In propaganda:* 90% of the population should *hate* a specific behaviour when they have heard the arguments.
- In *advertising*: 50% of the readers should *buy* the new consumer product within two weeks.
- In *marketing*: The market share for a particular product must increase from ten to 25% within one year.

The actual numbers, with respect to percent and allowed time, have to be decided in each specific case.

Information design objectives

Information design includes knowledge areas like technical illustration, technical writing, technical communication, informative layout, lexi-visual layout, communication design, visual interface design, and parts of information ergonomics, and design of graphical user interfaces. In information design the main objective is to provide information materials needed by the interpreter in order to perform specific tasks. The information interpreter might be seen as a "doer".

In information design it may be an advantage to use verbs like *apply, arrange, assemble, build, change, code, complete, compose, conduct, construct, cut, demonstrate, develop, draw, explain, find, generate, get, identify, illustrate, install, label, locate, make, modify, name, operate, pack, paste, predict, prepare, produce, put, read, recognise, reconstruct, remove, revise, sort, specify, start, type, verify,* and *write* in the writing of information design objectives. These verbs all denote observable behaviour. A few examples of performance objectives in information design may be:

- *For a computer interface:* 95% of the users should be able to *start* a new application within five minutes.
- *For an exhibition:* 90% of adult visitors should be able to *read* the texts on labels used in the exhibition without any difficulty.
- *For an instruction:* 90% of the customers should be able to follow the instructions, *put* the different parts together, and *build* a complete set of furniture within 15 minutes.
- *For a list:* 90% of the users should be able to *get* correct information about flight departure and arrival times within two minutes.
- *For a manual:* 80% of the customers should be able to *install* the new computer software within 15 minutes.
- *For a traffic information system:* 100% of motorists should *recognise* the signs while they are passing during night.

The actual numbers, with respect to percent and allowed time, have to be decided in each specific case.

When performance is qualitative rather than quantitative, the performance may be assessed by a group of experts. It should be noted that there is an increasing incidence of law suits being brought against manufacturers in the USA. These law suits claim damages as a result of accidents occurring, or products breaking because of poor quality in the language of instruction manuals (Helyar, 1992). The courts are demanding that technical manuals, brochures, information sheets, and labels be written in comprehensible language, and that descriptions and instructions *be readable and legible*. Everywhere, plaintiffs' counsels are searching frenetically for sections of text and parts of pictures that might be interpreted in conflicting ways. If a manufacturer's technical documentation is difficult to understand, he can lose a lawsuit and then have to pay large sums of money.

Instruction design objectives

Instruction design includes knowledge areas like audio-visual instruction, educational technology, instructional technology, visual literacy, technology of instruction, instructional design, instructional message design, and design of instructional materials . In instruction design the main objective is to provide courses and learning materials needed by the interpreter in order to modify behaviour with respect to learning. The information interpreter might be seen as a "learner".

In instruction design it may be an advantage to use verbs like *apply, arrange, complete, compose, conduct, construct, define, demonstrate, explain, find, identify, illustrate, label, modify, name, predict, prepare, recognise, reconstruct, revise, specify, verify,* and *write* in the writing of instruction design objectives. These verbs all denote observable behaviour. A few examples of performance objectives in instruction design may be:

- *For an exercise:* 100% of the students should be able to *complete* a the exercise within 15 minutes.
- *For an excursion:* 100% of the students should be able to *identify* and *name* five of the most common flowers in the area during the excursion.
- *For an experiment:* 90% of the students should be able to *explain* the various steps in the experiment.
- *For an educational video program:* 90% of the students should be able to *illustrate* the main topic in the program.
- *For a textbook:* 90% of the users should be able to *reconstruct* a segment of a text within ten minutes.
- *For a textbook:* 90% of the users should be able to *explain* four ideas presented in the text.

Also here the actual numbers, with respect to percent and allowed time, have to be decided in each specific case.

Message objectives diagrams

In an attempt to compare different kinds of mediated products I have used a triangular diagram, based on perceived experiences of various kinds of media products. The corners in the triangle represented learning and new knowledge, experiencing feelings, and understanding of facts (Figure 6).

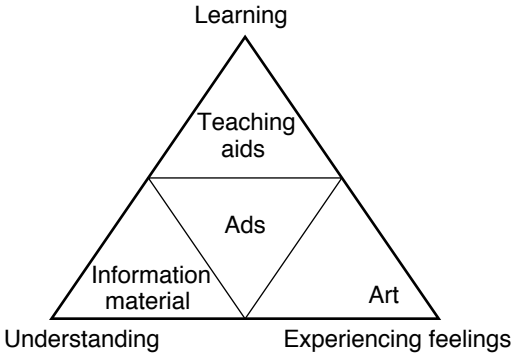


Figure 6. A message triangle. In this triangle the corners represent (1) learning and new knowledge, (2) experiencing feelings, and (3) understanding of facts.

This *message triangle* was further developed into a rhomb in order to better cope with various message objectives in different media. The *message objectives diagram* is a rhomb, divided in four parts of equal size (Figure 7). Each part represents different sets of objectives and receiver activities that may be noted as a cognitive state of mood.

The first part, *learning* and subsequent knowledge is located in the top corner. Knowledge may develop into insight and wisdom. The second part is the right corner. It represents *experiencing feelings* such as beliefs, delight, desire or willingness to buy something, distress, dread, eagerness, excitement, fear, fun, grief, hapiness, mourning, opinions, pleasure, prejudices, romance, satisfaction, sorrow, and tension. The third part, at the bottom corner represents *relaxation*, such as ease, rest, and slackening. The fourth part, at the left corner represents *understanding*, including awareness, consciousness, and understanding of facts.

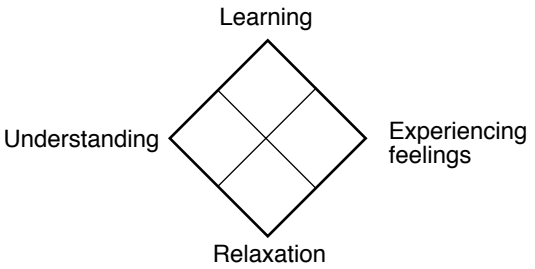


Figure 7. A message objectives diagram. In this rhomb the corners represent different objectives, (1) learning and new knowledge, (2) experiencing feelings, (3) relaxation, and (4) understanding of facts.

The message objectives diagram may be used for an easy visual presentation of similarities and differences between the materials and products that are the results of work within various message design areas. It is quite obvious that the objectives for a phone book is very different from the objectives for an advertisement, a detective story, or a lawbook. There are also products with two, or even more objectives. As an example the objectives for an educational TV-program may be to create an understanding, as well as learning of some facts. The objectives with entertainment in TV may be to provide relaxation and fun (Figure 8).

The objectives with *information set design* disciplines may be summarised in the following way:

- In *graphic design* the main intentions are to provide functional, aesthetic, and organised structure to all kinds of information sets. The interpreter/s may develop new views, relaxation, emotions, awareness, attention, understanding, and awareness.
- In *persuasive design* the main intentions are to provide advertising or propaganda in order to persuade interpreters to buy a product or a service, or to change behaviour. The interpreter/s may develop new prejudices, apprehensions, willingness to buy, beliefs, reinforced attitudes, emotions, opinions, and views.
- In *mass design* the main intentions are to provide news, views, and entertainment. The interpreter/s may develop views, relaxation, emotions, and awareness.
- In *information design* the main intentions are to provide information materials needed by the interpreter in order to perform a specific task. The interpreter/s may develop new skills, understanding, and experience.
- In *instruction design* the main intentions are to provide courses and learning materials needed by the interpreter in order to modify behaviour with

respect to learning. The interpreter/s may develop new understanding, experience, comprehension, knowledge, insight, and finally wisdom.

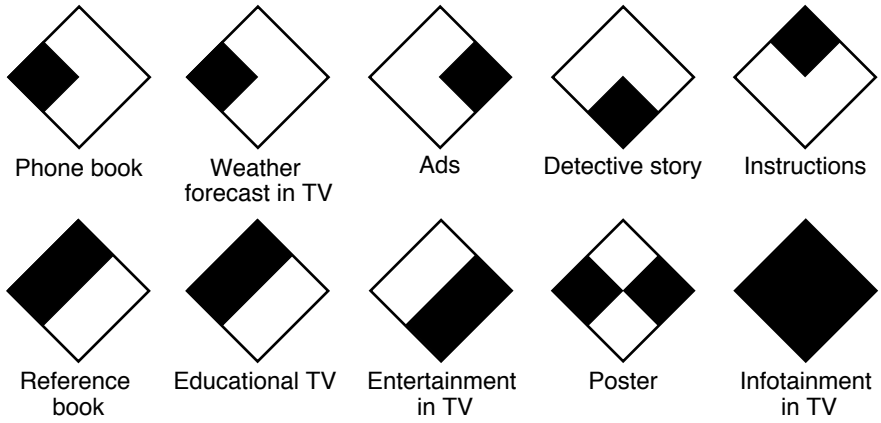
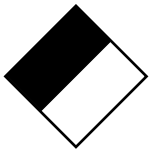
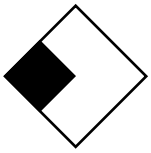
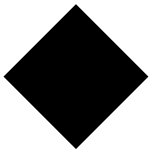
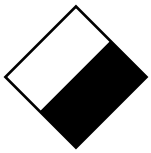
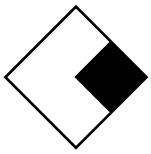


Figure 8. Examples of ten message objectives diagrams for different kinds of messages in materials and products. Please note that messages in different media look the same in the diagrams when the objectives are the same.

Conclusions

Various areas of design have different objectives and the materials and products reach out to different groups of receivers. Table 1 is an attempt to summarise message design areas, message designer´s main objectives, as well as interpreters activities and the results of these activities. (The message design areas are defined in the previous section.)

Table 1. Information set design areas, their intentions, cognitive activities and results. The cognitive activities are more advanced in the upper levels of the table than in the lower levels.

Design area	*Designer's main intentions*	*Information interpreter*	
		Activities	*Resulting in:*
instruction design 	to provide courses and learning materials needed by the interpreter in order to modify behaviour with respect to learning	learning understanding "learner"	wisdom insight knowledge comprehension experience understanding
information design 	to provide information materialsneeded by the interpreterin order to performa specific task	understanding comprehending interpreting "doer"	experience understanding skills
graphic design 	to provide functional, aesthetic, and organised structure to all kinds of information sets	reading viewing comprehending interpreting noticeing "reader"	understanding attention awareness emotions relaxation views
mass design 	to provide news, views, and entertainment in order for the interpreter to create awareness and relaxation	comprehending interpreting noticeing "relaxer"	awareness emotions relaxation views
persuasive design 	to provide advertising or propaganda in order to persuade interpreters to buy a product or a service, or to change behaviour	noticeing perceiving "possible buyer"	views opinions emotions reinforced attitudes beliefs willingness to buy apprehensions prejudices

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Gearing communications

Abstract. *Knowledge of graphic design, information design, visual communication, visual language, and visual literacy might be important for our ability to better produce effective messages — "messages that really work". In this study eight groups of ID students ranked lists of "information design characteristics", a total of 50 research findings. These masters students were asked to discuss and rank how they perceive the importance of research findings related to (1) sender processes, (2) text design, (3) image design, (4) graphic design, and (5) receiver processes.*

We need many information utility goods in order to perform our tasks at work. We also need an increasing amount of information materials during our leisure time, in order to be able to handle things like cameras, cars, CD-players, computers, computer software, etc. A well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources. Information design may be described in the following way:

> In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message – its content, language and form. Regardless of the selected medium, a well designed information set will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. (Pettersson, 1998a, 2002)

Information design is a multi-disciplinary, multi-dimensional, and worldwide consideration with influences from areas such as language, art and aesthetics, information, communication, behaviour and cognition, business and law, as well as media production technologies. Information designers, technical writers and others who want to produce information sets and learning materials may all benefit from the results of research related to message design, text design, image design, graphic design, and cognition. These are all important areas of information design.

Message design. We are today living in mass-media societies. Every day we are bombarded with information. Visual messages in different forms are increasingly important. The study of presentation of verbo-visual messages is a multi-disciplinary, multi-dimensional and worldwide consideration.

Text design. There are many kinds of languages. Results from research explain some of the characteristics of verbal language, spoken as well as written. Combinations of different kinds of languages may be used in communication.

Image design. Results from research explain some of the characteristics of visual language. Its functions, levels of meaning, properties, and structure may be explained. Combinations of different kinds of languages are used in mass communication. Yet little is known about the effects of various linguistic combinations. Different linguistic combinations must be studied in detail before optimum combinations can be found for various purposes.

Graphic design. Although we may not think about it, the practice of graphic design is as old as recorded history. We see the results of graphic design every day. Often graphic design is thought of with regard to the print medium, but it is used in all media. Graphic design is the art and craft of bringing a functional, aesthetic, and organized structure to groups of diverse elements. These elements may be headings, texts, pictures, captions, tables, and even sounds and motion in motion pictures, on television, and computers.

Cognition. Results from research may explain some of the functions related to our senses, attention, perception, processing, mental images, and application of new knowledge. The goal of communication-oriented design of messages should always be *clarity of communication*. In information design the task of the sender or source is actually not completed until the receivers or interpreters have received and understood the intended message.

There are more areas of information design such as audio design, exhibition design, event design, light design, time design as well as modern web design. These areas are, however, not included in this study. For this study some of our information design students are ranking findings from research.

Findings from research

For many years I have "collected" research findings that I personally felt were important for the understanding of information design, visual communication, visual language, and visual literacy. This body of knowledge might be important and interesting for our ability to better produce effective messages — "messages that really work". Thus I have put together lists of "information design characteristics", a total of 50. The research findings discussed in this study are listed below. Here they are sorted according to the final rank order that was the result of the study.

Sender processes

1. Communication is not complete until the receivers understand the messages. Information materials shall be legible, readable and well worth reading for the intended audience (Pettersson, 1989).
2. Information is most useful to have exactly at the time when we need it (Pettersson, 1998b).
3. We have to adopt verbal as well as visual messages to suit each group of receivers. (Pettersson, 1998b)
4. The graphical message's *legibility* is determined by the technical design of the text and the pictures, that is, their *clarity*. Good legibility is always economically advantageous, whereas poor legibility is a costly business. (Pettersson, 1993)
5. Information materials which provides the wrong information may give a *negative result*, and the learner may end up *less competent* than before the learning experience. (Pettersson, 1993)
6. It is better not to have any pictures at all than employing pictures with poor quality (Pettersson, 1989).
7. The perception of linear representations requires slow, sequential, processing for comprehension of content. (Perfetti, 1977; Sinatra, 1986)
8. Image manipulation implies the improper control of people's perception of a given reality through the use of pictures.(Pettersson, 2002)
9. The classical "borders" between the media groups will dissolve. In the future most media will interact and partly overlap each other. (Pettersson, 1989).
10. Word identification is a multi-stage process. Visual-featural analysis is carried out by the right brain hemisphere. Word naming and word meaning are processed by the left hemisphere. (Pirozzolo and Rayner, 1979)

Text design

1. It may take only 2-3 seconds to recognize the content in an image (Paivio, 1979; Postman, 1979), but 20 – 30 seconds to read a verbal description of the same image (Lawson 1968; Ekwall, 1977) and 60 – 90 seconds to read it aloud (Sinatra, 1986). In verbal and visual languages prior experience and context are very important to the perception of contents.
2. When illustrations provide text-redundant information, learning information in the text that is also shown in pictures will be facilitated. (Levie and Lentz, 1982; Melin, 1999).
3. There is no direct correspondence between groups of letters, words, and reality. Each meaning is defined and must be learned. (Elkind, 1975)

4. When illustrations are not relevant to prose content they can have a negative effect. (Levie and Lentz, 1982; Melin, 1999)
5. Perception of verbal content is apparently easier when a text is read than heard. Thus it is easier to assimilate and profit from a rich language by reading than by listening (Pettersson, 1986).
6. People usually have no difficulty in reading the jargon used in professional or technical languages but understanding the concepts the words represent may be difficult for a non-specialist (Melin, 1986b).
7. The more abstract a word is the harder it is to relate it to any specific activity (Melin, 1986a).
8. Verbal languages have varying levels of meaning (Eco, 1971): (i) phonemes (without meaning); (ii) morphemes (with meaning); (iii) syntagms, submeanings; (iv) complete meanings.
9. The end of a sentance should be determined by syntax rather than by a set width of a line. (Hartley, 1980; Bork, 1982)
10. A written text can convey information, contain analyses and describe feelings and facts. (Melin, 1986a)

Image design

1. Content is more important than execution, context, and format. Pictures have a strong emotional impact. (Pettersson; 1987, 1989)
2. Seeing is believing. Most people believe that pictures tell the truth. (Lefferts, 1982)
3. The same visuals are not equally effective for learners in different grade levels, and for learners with different prior knowledge. (Dwyer, 1972)
4. Persuasion tends to be accomplished in both children and adolescents almost exclusively through imagery. (Barry, 1998)
5. The effectiveness of a visual depends on the medium, on the type of information, and also on the amount of time learners are permitted to interact with the material. (Dwyer, 1972)
6. All types of visuals are not equally effective. Line drawings are most effective in formats where the learner's study time is limited. More realistic versions of art work, however, may be more effective in formats where unlimited study time is allowed. (Dwyer, 1972)
7. Visual languages attempt equivalence with reality. Visuals are iconic. They normally resemble the thing they represent. Meaning is apparent on a basic level, but the visual language must be learned for true comprehension. (Pettersson, 1989)

8. The same intended theme or subject can be expressed through many different pictures. (Pettersson, 1986)
9. Perception of two- or three-dimensional representations entails fast, parallel, simultaneous, and holistic processing. (Gazzaniga, 1967; Sperry, 1973, 1982)
10. Visual languages have analogue coding employing combinations of basic graphic elements (dots, lines, areas, and volumes) for depicting reality. A given set of basic elements can be combined to form completely different images. (Pettersson, 1987)

Graphic design

1. Dissatisfaction with the execution of a message may cause dissatisfaction with the content of the message. (Pettersson, 1989).
2. Most pictures are capable of several interpretations until anchored to one by a caption. (Barthes, 1977)
3. Learners are most able to build connections between verbal and visual representations when text and illustrations are actively held in memory at the same time. This can happen when text and illustrations are presented in close connection on the same page in a book, or when learners have sufficient experience to generate their own mental images as they read the text. (Mayer et al., 1995)
4. It is more likely that graphically complex texts will be read than "plain" texts. (Melin, 1999)
5. Readers often react in a positive way to graphically complex texts. Texts with good typography will be noticed. (Melin, 1999)
6. The decision of which font or which fonts to use should rest largely on the purpose and audience of the document (Benson, 1985).
7. It takes less time to read a graphically complex text than a "plain" text. (Melin, 1999)
8. If pictures are not adequately discussed and explained, they will probably not be properly understood. (Zimmermann and Perkin, 1982)
9. Lenze (1991) noted that private documents may invite the use of ornate and stylish looking fonts. Professional documents, however, require maximum legibility (Tinker, 1963; Benson, 1985; Pettersson, 1989).
10. Text which should be read in a continuous manner should be set between nine and twelve Pica points (Tinker, 1963; Haber and Haber 1981; Benson, 1985; Braden, 1983, 1985).

Receiver processes

1. Memory for pictures is superior to memory for words (Paivio, 1983; Branch and Bloom, 1995). This is called the "pictorial superiority effect".
2. Visual languaging abilities develop prior to, and serve as the foundation for, verbal language development. (Reynolds-Myers, 1985; Moriarty, 1994)
3. Images and visual language speak directly to us in the same way experience speaks to us: holistically and emotionally. (Barry, 1998)
4. Memory for a picture-word combination is superior to memory for words alone or pictures alone. (Adams and Chambers 1962; Haber and Myers, 1982)
5. Development of visual languaging abilities is dependent upon learner interaction with objects, images, and body language. (Reynolds-Myers, 1985).
6. Both students and teachers have to learn how to read, how to create and how to use visuals. (Pettersson, 1990)
7. Because children developmentally cannot or do not pay attention to factual information in advertising – but rather to peripheral cues such as colour and imagery – they tend to process advertising not through logical assessment, but through their emotions. (Barry, 1998)
8. Comprehensive school students have a very poor pictorial capability. They are poor at reading and understanding pictures. They are also poor at expressing themselves with pictures. (Backman, Berg and Sigurdson, 1988; Eklund, 1990)
9. People who have not learned to read or write do not necessarily look at pictures in the order intended. It often proves helpful, as messages are being tested, to ask several groups of people to arrange the individual message into a sequence that seems most logical to them. (Zimmermann and Perkin, 1982)
10. The pattern for eye movements and fixations depends on what we wish to see, or are told to see in a picture. (Yarbus, 1967)

What do our masters level information design students think about these research findings? Is it possible for them to rank the importance of the findings? Which findings are considered to be the most and the least important? Some are probably seen as more important than others. Based on such assessments it might also be possible to develop some of the items on these lists into practical guidelines that may be of interest for those producing materials for information and learning. There may, however, exist a large number of other research findings than those I have selected for this specific study.

Research method

In a distance learning course in "Information Design" our masters level students in Sweden participated in this "ranking study" during the spring of 2002, and masters level students in the USA during the fall of 2002. This masters level course is administrated by the Department of Innovation, Design and Product Development at Mälardalen University in Sweden and by the Distance Learning Graduate Program at Appalachian State University in the USA. In each case the students worked in groups of four to six persons. The groups were asked to discuss and rank how they perceive the importance of the research findings presented in the previous section. In the field study each of the five sets of research findings were sorted and presented in a random order.

If all groups deliver exactly the same rank order for a group of ten research findings this will be seen in a diagram as bars with an even and exact distribution, from rank one to ten (Figure 1). This pattern shows "total agreement" and total consensus between the different groups.

The opposite is a situation when all groups have different opinions regarding the rank order. In this case all the ten bars will have the same size, and they will all stop at the mean rank level of five. This pattern shows a "total disagreement" and a total lack of consensus between the groups (Figure 2).

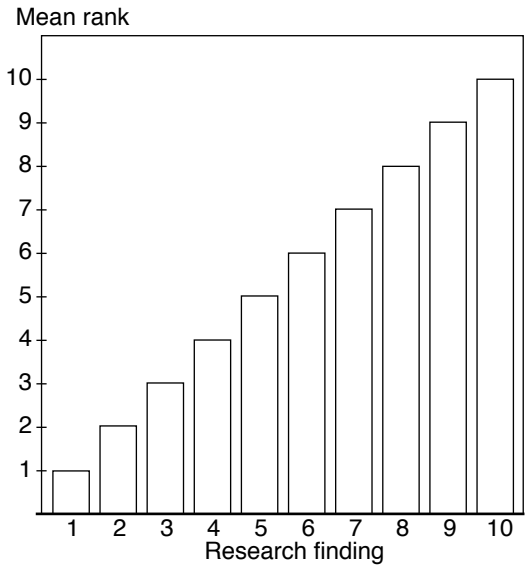

Figure 1. If all groups deliver exactly the same rank order of a group of ten research findings this will be seen in a diagram like this one. Please note that a high rank is shown in this diagram as a short bar. This diagram represents "total agreement" between the groups.

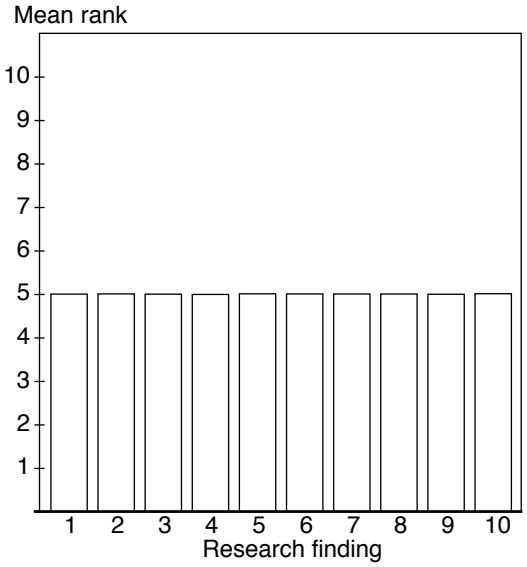

Figure 2. If all groups have different opinions regarding the rank order all findings will have the same mean rank. Thus all bars will be equal in size. This diagram represents "total disagreement" between the groups.

Data and results

The 36 Swedish students worked in six study groups. The ten North American students worked in two study groups. Thus a total of 46 subjects have been involved in the ranking processes. The results are presented in the following five figures as well as in an Appendix with five tables.

Practically all of the groups reported that it was a difficult task to rank these research findings. They felt that all of the findings were "important". However, after vivid discussions in the groups they somehow managed to reach an agreement on a rank order for each set of ten research findings.

In a statistical analysis the agreements between the rankings made by the groups of students were estimated with Cronbachs alpha. For the set of research findings presented in the following five figures and in the tables in the appendix (Table 1 – 5) alpha levels of .94, .88, .77, .64, and .64 respectively was obtained. Thus the inter-scorer reliability was extremely high for findings regarding "sender processes" (Figure 3). The inter-scorer reliability was high for findings regarding text design and image design (Figures 4 and 5). Finally the inter-scorer reliability was quite low for findings regarding graphic design and receiver processes (Figures 6 and 7).

In another statistical analysis the Spearmans rho between the rankings made by the groups of students was calculated for each set of research findings. Those correlation coefficients were analysed with a repeated measures analysis of variance (ANOVA) with each set of research findings as the within-subject factor. The ANOVA showed that the level of agreement between the rankings made by the groups of students depended on type of the research findings $F(2.83, 76.44) = 15.759$, $p < .001$ (Greenhouse-Geisser adjusted degrees of freedom). Post-hoc tests (Scheffé) revealed that the correlations between the rankings made by the groups of students for sender processes (Figure 3) was significantly larger than those for image design , text design and graphic design (Figures 4, 5 and 6). The correlations between the rankings made by the groups of students for text design (Figure 4) was significantly larger than those for graphic design and receiver processes (Figure 6 and 7).

Sender processes

Several groups have reported that it is a hard task to rank the importance of research findings without a specific context or a certain and common perspective on the area. The sender processes are multi-dimensional. This dictates that a multitude of factors must be taken into consideration for ranking. However, despite these considerations and these problems individuals and groups actually have been able to do the ranking of research findings regarding the sender processes. Here subjects really agree. It is remarkable to note that the ranking of the importance of the research findings between these groups have very little variance. This is true for the Swedish groups as well as for the two groups from the USA. Rank 1 is significantly better than ranks 3 – 10. Rank 4 is better than ranks 7 – 10, and ranks 5 – 6 are better than rank 10. The results are shown in Figure 3 and in Table 1.

Rank 1. "Communication is not complete until the receivers understand the messages. Information materials shall be legible, readable and well worth reading for the intended audience (Pettersson, 1989)."

Rank 2. "Information is most useful to have exactly at the time when we need it (Pettersson, 1998b)."

Rank 3. "We have to adopt verbal as well as visual messages to suit each group of receivers. (Pettersson, 1998b)"

Rank 4. "The graphical message's *legibility* is determined by the technical design of the text and the pictures, that is, their *clarity*. Good legibility is always economically advantageous, whereas poor legibility is a costly business. (Pettersson, 1993)"

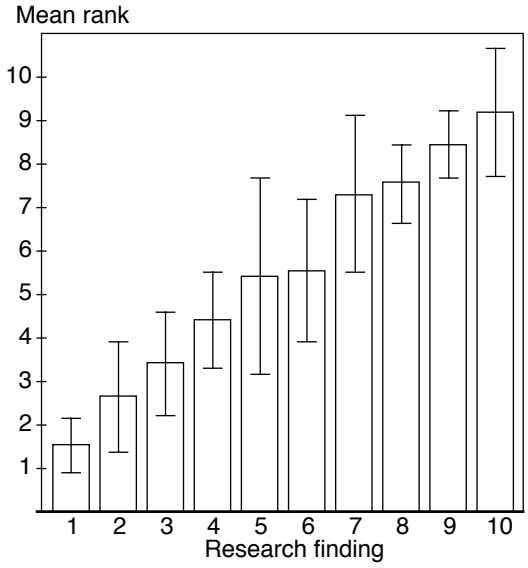

Figure 3. Sender processes. Here rank 1 is significantly better than ranks 3 – 10. Rank 4 is significantly better than ranks 7 – 10, and ranks 5 – 6 are significantly better than rank 10. This area of knowledge is mainly characterised by strong agreements between the groups.

Text design

The opinions on the research findings on text design form three groups. There is a strong agreement between all groups in this study with respect to the two most important research findings, ranks 1 and 2. Rank 1 is significantly better than ranks 2 – 10, and rank 2 is better than groups 6 – 10. The results are shown in Figure 4 and Table 2.

Rank 1. "It may take only 2-3 seconds to recognize the content in an image (Paivio, 1979; Postman, 1979), but 20-30 seconds to read a verbal description of the same image (Lawson 1968; Ekwall, 1977) and 60-90 seconds to read it aloud (Sinatra, 1986). In verbal and visual languages prior experience and context are very important to the perception of contents."

Rank 2. "When illustrations provide text-redundant information, learning information in the text that is also shown in pictures will be facilitated. (Levie and Lentz, 1982; Melin, 1999)."

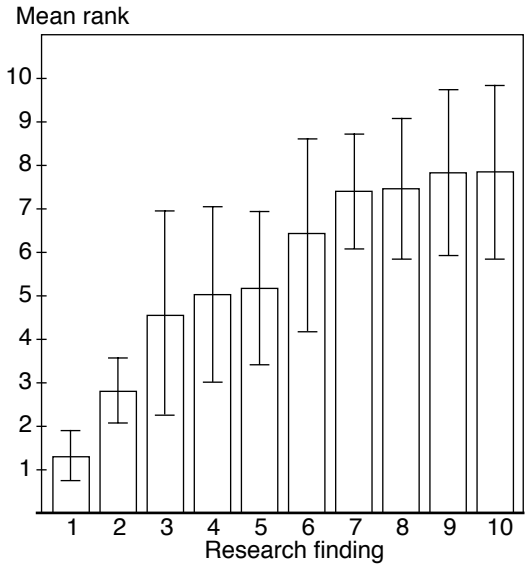

Figure 4. Text design. Rank 1 is significantly better than ranks 2 – 10, and rank 2 is significantly better than groups 6 - 10. There are disagreements between the groups for the remaining eight findings.

As we can see in the figure above, there is not much of a difference between the groups with respect to their opinions of the importance of the remaining and least important research findings. It may be concluded that the subjects in this study to a large extent disagree on the importance of research findings related to text design.

Image design

This area of knowledge is mainly characterised by disagreements between the groups. The opinions on the research findings on image design form three groups. There is a strong agreement between all groups with respect to the most important research findings. Rank 1 is significantly better than ranks 6 – 10. Rank 2 is significantly better than rank 10. The results are shown in Figure 5 and in Table 3.

Rank 1. "Content is more important than execution, context, and format. Pictures have a strong emotional impact. (Pettersson; 1987, 1989)."

Rank 2. "Seeing is believing. Most people believe that pictures tell the truth. (Lefferts, 1982)"

As we can see in figure 5 there is not much of a difference between the groups with respect to their opinions of the importance of the other findings. These findings are the least important. This distribution is rather similar to that of text design. It may be concluded that the subjects in this study to a large extent disagree on the importance of of the selected research findings related to image design.

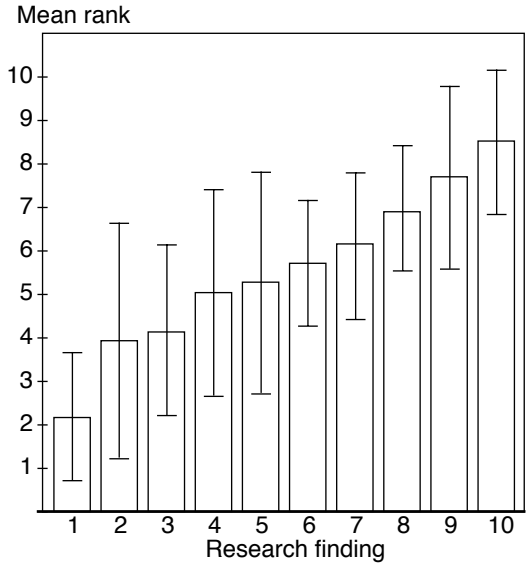

Figure 5. Image design. Rank 1 is significantly better than ranks 6 – 10. This area of knowledge is mainly characterised by disagreements between the groups.

Graphic design

This area of knowledge is mainly characterised by strong disagreements between the groups of students. In this area the groups reported that their "opinions varied wildly" when they worked with this specific assignment. It seems that individual agendas, backgrounds, cultures, differences and experiences cause more disagreements than in the previous areas.

However, there is a strong agreement between all groups with respect to the most important research finding. The first rank is significantly better than ranks 5 – 10. The results are shown in Figure 6 on the next page and in Table 4 in the appendix.

Rank 1. "Dissatisfaction with the execution of a message may cause dissatisfaction with the content of the message. (Pettersson, 1989)."

With respect to the area of graphic design it may be concluded that the subjects in this study to a large extent disagree on the importance of the selected research findings.

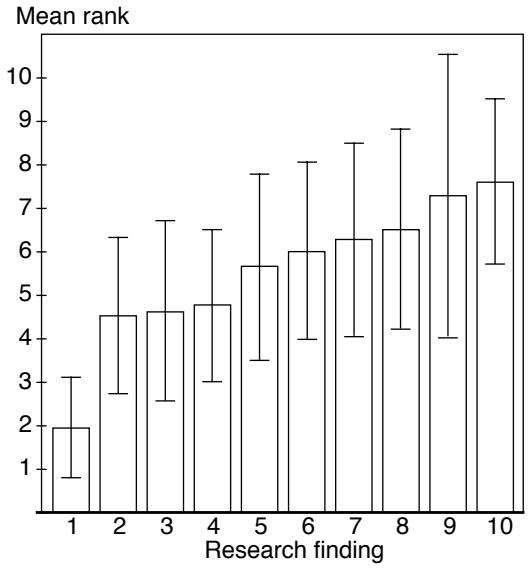

Figure 6. Graphic design. Here rank 1 is significantly better than ranks 5 – 10. This area of knowledge is mainly characterised by disagreements between the groups.

Receiver processes

As individuals we differ in the ways we perceive any given stimulus. This seems to be valid also when we are engaged in interpretation of research findings. Also this area of knowledge is mainly characterised by strong disagreements between the individuals and between the groups of students. Also in this area the groups reported that their "opinions varied wildly" when they worked with this specific assignment. It seems that individual agendas, backgrounds, cultures, differences and experiences cause many disagreements.

The opinions on the research findings on cognition and receiver processes may be seen to form two groups. There is agreement regarding the top two rankings of research findings, at the bottom of the diagram. Ranks 1 and 2 are significantly better than ranks 8 and 10.

Rank 1. "Memory for pictures is superior to memory for words (Paivio, 1983; Branch and Bloom, 1995). This is called the "pictorial superiority effect".

Rank 2. "Visual languaging abilities develop prior to, and serve as the foundation for, verbal language development. (Reynolds-Myers, 1985; Moriarty, 1994)".

It may be concluded that the subjects in this study to a large extent disagree on the importance of research findings related to receiver processes. The results are shown here in Figure 8 and in Table 5.

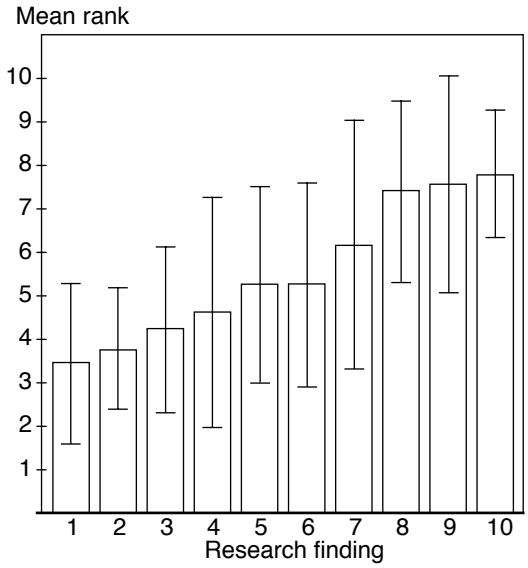

Figure 7. Receiver processes. Here ranks 1 and 2 are significantly better than ranks 8 and 10. This area of knowledge is mainly characterised by disagreements between the groups.

Guidelines for designers

Based on the results of these rankings of research findings it may be possible to make a small and restricted easy to remember and easy to use "set of guidelines" that would help us to improve the quality of information materials that we need to produce for our information design students. At present we use the following guidelines in our own work.

Sender processes

1. Define what any message is supposed to show, always keeping the audience in mind.
2. Analyse the intended message and create a synopsis, an overview of the forthcoming information or learning material.

3. Do not include too much realism in the representations because it may detract from the learning processes. A moderate amount of carefully selected realism often provides the best representation.

Text design

1. Provide the time that is necessary for the audience. It may take quite a long time to perceive and interpret a verbal message. A message is only comprehensible if it can be grasped by the receiver without difficulty.
2. Ensure that the context of messages are seen and can convey a "pre-understanding" of the contents. Prior experience and context are important to the perception of contents.
3. Provide illustrations with text-redundant information in order to facilitate understanding and learning. Do not always assume that everyone is "literate".

Image design

1. Consider that pictures have a strong emotional impact. Image content is more important than its execution, context, and format.
2. Consider how an image may be perceived. Most people still believe that pictures "tell the truth".
3. Define the objective for each visual. The same visuals are not equally effective for people with different prior knowledge. The context in which a message is presented impacts the perception of the message.

Graphic design

1. Adjust the execution of a message to its content.
2. Design for clarity and optimum legibility. Keep the graphical form simple and direct. Use regular type for continuous text. Bold and italics may be used for emphasis and headings.
3. Present text and illustrations in close connection. Use legends to explain pictures.

Receiver processes

1. Create *combined verbal and visual messages* when the message content is complex factual information. Visual language abilities develop prior to, and serve as the foundation for, verbal language development. Memory for pictures is superior to memory for words.

2. Create *verbal messages* when the message content is analytical, detailed, logical, narrative, theoretical, and sequential.
3. Create *visual messages* when the message content is emotional, holistic, immediate, spatial and visual. Images and visual language speak directly to the audience.

Despite the restricted number of subjecs in this study it is quite possible that these guidelines will be valuable when any information designer has to produce information sets for other groups of receivers. Our long term goal is to be able to create information design guidelines of a "general nature" for broader audiences. Thus our studies will continue. Thus it is possible that some guidelines will be changed or replaced in the future.

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Appendix

The following five tables show the rankings of research findings by masters level students from Sweden (groups 1 – 6) and from USA (groups 7 – 8). A total of 46 persons took part in this study. In each table mr = mean rank.

Table 1. Sender processes.

Research findings	*Ranks by groups*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*mr*
Communication is not complete until the receivers understand the messages. Information materials shall be legible, readable and well worth reading for the intended audience (Pettersson, 1989).	1	1	1	2	1	2	3	1	1.5
Information is most useful to have exactly at the time when we need it (Pettersson, 1998b).	4	2	2	1	4	4	1	2	2.8
We have to adopt verbal as well as visual messages to suit each group of receivers. (Pettersson, 1998b)	3	3	6	3	2	5	2	3	3.4
The graphical message's legibility is determined by the technical design of the text and the pictures, that is, their clarity. Good legibility is always economically advantageous, whereas poor legibility is a costly business. (Pettersson, 1993)	5	6	3	6	3	3	5	4	4.4
Information materials which provides the wrong information may give a negative result, and the learner may end up less competent than before the learning experience. (Pettersson, 1993)	6	10	8	4	4	1	4	5	5.3
It is better not to have any pictures at all than employing pictures with poor quality (Pettersson, 1989).	2	5	5	5	9	6	6	6	5.5
The perception of linear representations requires slow, sequential, processing for comprehension of content. (Perfetti, 1977; Sinatra, 1986)	9	4	4	9	8	9	8	7	7.3
Image manipulation implies the improper control of people's perception of a given reality through the use of pictures.(Pettersson, 2002)	7	7	7	8	7	7	7	10	7.5
The classical “borders” between the media groups will dissolve. In the future most media will interact and partly overlap each other. (Pettersson, 1989).	8	8	9	7	10	8	9	8	8.4
Word identification is a multi-stage process. Visual-featural analysis is carried out by the right brain hemisphere. Word naming and word meaning are processed by the left hemisphere. (Pirozzolo and Rayner, 1979)	10	9	10	10	4	10	10	9	9.0

Table 2. Text design.

Research findings	*Ranks by groups*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*mr*
It may take only 2-3 seconds to recognize the content in an image (Paivio, 1979; Postman, 1979), but 20 – 30 seconds to read a verbal description of the same image (Lawson 1968; Ekwall, 1977) and 60 – 90 seconds to read it aloud (Sinatra, 1986). In verbal and visual languages prior experience and context are very important to the perception of contents.	1	1	3	1	1	1	1	1	1.3
When illustrations provide text-redundant information, learning information in the text that is also shown in pictures will be facilitated. (Levie and Lentz, 1982; Melin, 1999).	4	3	2	3	2	4	2	2	2.8
There is no direct correspondence between groups of letters, words, and reality. Each meaning is defined and must be learned. (Elkind, 1975)	2	8	1	8	4	7	3	3	4.5
When illustrations are not relevant to prose content they can have a negative effect. (Levie and Lentz, 1982; Melin, 1999)	5	4	10	2	5	3	6	4,5	5.0
Perception of verbal content is apparently easier when a text is read than heard. Thus it is easier to assimilate and profit from a rich language by reading than by listening (Pettersson, 1986).	3	2	4	7	7	8	5	4,5	5.1
People usually have no difficulty in reading the jargon used in professional or technical languages but understanding the concepts the words represent may be difficult for a non-specialist (Melin, 1986b).	6	6	8	9	3	2	9	7,5	6.3
The more abstract a word is the harder it is to relate it to any specific activity (Melin, 1986a).	9	7	7	5	6	10	7	7,5	7.4
Verbal languages have varying levels of meaning (Eco, 1971): (i) phonemes (without meaning); (ii) morphemes (with meaning); (iii) syntagms, sub-meanings; (iv) complete meanings.	7	9	5	6	10	5	8	9	7.4
The end of a sentance should be determined by syntax rather than by a set width of a line. (Hartley, 1980; Bork, 1982)	8	10	6	4	8	6	10	10	7.8
A written text can convey information, contain analyses and describe feelings and facts. (Melin, 1986a)	10	5	9	10	9	9	4	6	7.8

Table 3. Image design

Research findings	*Ranks by groups*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*mr*
Content is more important than execution, context, and format. Pictures have a strong emotional impact. (Pettersson; 1987, 1989)	1	1	1	2	1	3	2	6	2.1
Seeing is believing. Most people believe that pictures tell the truth. (Lefferts, 1982)	9	8.5	4	1	3	1	3.5	1	3.9
The same visuals are not equally effective for learners in different grade levels, and for learners with different prior knowledge. (Dwyer, 1972)	7	2	2	8	2	4	5	3	4.1
Persuasion tends to be accomplished in both children and adolescents almost exclusively through imagery. (Barry, 1998)	8	3	3	9	6	2	7	2	5.0
The effectiveness of a visual depends on the medium, on the type of information, and also on the amount of time learners are permitted to interact with the material. (Dwyer, 1972)	2	5	8.5	10	5	6	1	4	5.2
All types of visuals are not equally effective. Line drawings are most effective in formats where the learner's study time is limited. More realistic versions of art work, however, may be more effective in formats where unlimited study time is allowed. (Dwyer, 1972)	5	4	8.5	7	7	5	3.5	5	5.6
Visual languages attempt equivalence with reality. Visuals are iconic. They normally resemble the thing they represent. Meaning is apparent on a basic level, but the visual language must be learned for true comprehension. (Pettersson, 1989)	6	8.5	5	3	4	8	6	8.5	6.1
The same intended theme or subject can be expressed through many different pictures. (Pettersson, 1986)	4	6	6	6	9	7	8.5	9	6.9
Perception of two- or three-dimensional representations entails fast, parallel, simultaneous, and holistic processing. (Gazzaniga, 1967; Sperry, 1973, 1982)	3	8.5	8.5	5	10	9	10	7	7.6
Visual languages have analogue coding employing combinations of basic graphic elements (dots, lines, areas, and volumes) for depicting reality. A given set of basic elements can be combined to form completely different images. (Pettersson, 1987)	10	8.5	8.5	4	8	10	8.5	10	8.4

Table 4. Graphic design.

Research findings	*Ranks by groups*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*mr*
Dissatisfaction with the execution of a message may cause dissatisfaction with the content of the message. (Pettersson, 1989).	2	1	2	1	2.5	1	5	1	1.9
Most pictures are capable of several interpretations until anchored to one by a caption. (Barthes, 1977)	8	2	5	3	6	6	2	4	4.5
Learners are most able to build connections between verbal and visual representations when text and illustrations are actively held in memory at the same time. This can happen when text and illustrations are presented in close connection on the same page in a book, or when learners have sufficient experience to generate their own mental images as they read the text. (Mayer et al., 1995)	3	3	7	8	6	6	1	3	4.6
It is more likely that graphically complex texts will be read than “plain” texts. (Melin, 1999)	5	5.5	9	5	2.5	3	3	5	4.8
Readers often react in a positive way to graphically complex texts. Texts with good typography will be noticed. (Melin, 1999)	4	9	8	4	2.5	3	7.5	7	5.6
The decision of which font or which fonts to use should rest largely on the purpose and audience of the document (Benson, 1985).	7	5.5	3	2	9	8	7.5	6	6.0
It takes less time to read a graphically complex text than a “plain” text. (Melin, 1999)	6	5.5	10	6	2.5	3	9	8	6.3
If pictures are not adequately discussed and explained, they will probably not be properly understood. (Zimmermann and Perkin, 1982)	9	9	6	10	6	6	4	2	6.5
Lenze (1991) noted that private documents may invite the use of ornate and stylish looking fonts. Professional documents, however, require maximum legibility (Tinker, 1963; Benson, 1985; Pettersson, 1989).	1	9	1	9	9	10	10	9	7.3
Text which should be read in a continuous manner should be set between nine and twelve Pica points (Tinker, 1963; Haber and Haber 1981; Benson, 1985; Braden, 1983, 1985).	10	5.5	4	7	9	9	6	10	7.6

Table 5. Receiver processes

Research findings	*Ranks by groups*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*mr*
Memory for pictures is superior to memory for words (Paivio, 1983; Branch and Bloom, 1995). This is called the "pictorial superiority effect".	5	2	2	7.5	2	5	2	1	3.4
Visual languaging abilities develop prior to, and serve as the foundation for, verbal language development. (Reynolds-Myers, 1985; Moriarty, 1994)	2	3	3	5	6	3	6	2	3.8
Images and visual language speak directly to us in the same way experience speaks to us: holistically and emotionally. (Barry, 1998)	7	7	4	1.5	5	1	5	3	4.2
Memory for a picture-word combination is superior to memory for words alone or pictures alone. (Adams and Chambers 1962; Haber and Myers, 1982)	6	1	1	7.5	3	10	2	5	4,6
Development of visual languaging abilities is dependent upon learner interaction with objects, images, and body language. (Reynolds-Myers, 1985).	3	4	9	1.5	8	6	2	7	5.2
Both students and teachers have to learn how to read, how to create and how to use visuals. (Pettersson, 1990)	9	8	8	3.5	4	4	1	4	5.2
Because children developmentally cannot or do not pay attention to factual information in advertising – but rather to peripheral cues such as colour and imagery – they tend to process advertising not through logical assessment, but through their emotions. (Barry, 1998)	1	5	5	10	9	2	8	9	6.1
Comprehensive school students have a very poor pictorial capability. They are poor at reading and understanding pictures. They are also poor at expressing themselves with pictures. (Backman, Berg and Sigurdson, 1988; Eklund, 1990)	4	9	7	3.5	7	8	10	10	7.3
People who have not learned to read or write do not necessarily look at pictures in the order intended. It often proves helpful, as messages are being tested, to ask several groups of people to arrange the individual message into a sequence that seems most logical to them. (Zimmermann and Perkin, 1982)	10	10	6	9	1	7	9	8	7.5
The pattern for eye movements and fixations depends on what we wish to see, or are told to see in a picture. (Yarbus, 1967)	8	6	10	6	10	9	7	6	7.8

Research in information design

Abstract. *Like architecture, engineering, and other broad disciplines, information design has a practical and a theoretical part. To a large extent research in information design consists of applied research. Critically selected results from other research areas may often be used as a starting point for the development of new theories. It may be concluded that the study of information design and the presentation of verbo-visual messages is a multi-disciplinary, multi-dimensional and worldwide consideration. Information literacy, visual language, visual literacy, perception and learning are important concepts here. Several different research methods are used in information design research.*

Design

In Sweden the National Agency for Higher Education (Högskoleverket) provides information about specific courses and complete academic programs that are available to students. On their web page *studera.nu* (study now) students may find information on current options. This database includes more than 700 academic disciplines. The word "design" gave more than one thousand "hits" on March 29th, 2005. A closer look at the documents for individual courses and programs show that many are very different.

What do we mean by the term *design*? It is related to the Latin word *designare*, to mark out, define; *de-*, out, from + *signare*, to mark (Little, 1965). In various definitions of the word design the authors note aesthetic and artistic properties as well as functional properties related to articles for everyday use.

We may conclude that the meaning of the word design is very broad and it encompasses several different concepts.

Pettersson (2002, p. 6) distinguished between several *design concepts* such as design processes, design activities, design areas, design levels, design perspectives, design discourse, and final designs.

A *design process* includes the development from a concept or an idea to a final product. Steps in the design process may be called *design activities*, such as: the work with conceptual design, embodiment design, detail design, and design reviews. Thus the design process includes cognitive as well as practical aspects and activities.

The concept *design areas* include many areas, or parts of areas. A few examples are apparel design, ceramics design, document design, environmental design, furniture design, graphic design, industrial design, information design, instruction design, package design, textile design and web design. The final products may be manufactured in various materials. A group of design disciplines all deal with the design of messages. One "family" of related design disciplines may be called "message design."

Message design is an interdisciplinary field of knowledge (Pettersson, 2002, p. 8). Message design encompasses influences and facts from more than fifty established academic disciplines and areas of research (Figure 1). These may be divided into language disciplines, art and aesthetic disciplines, information disciplines, communication disciplines, behavioural and cognitive disciplines, business and law, and media production technologies.

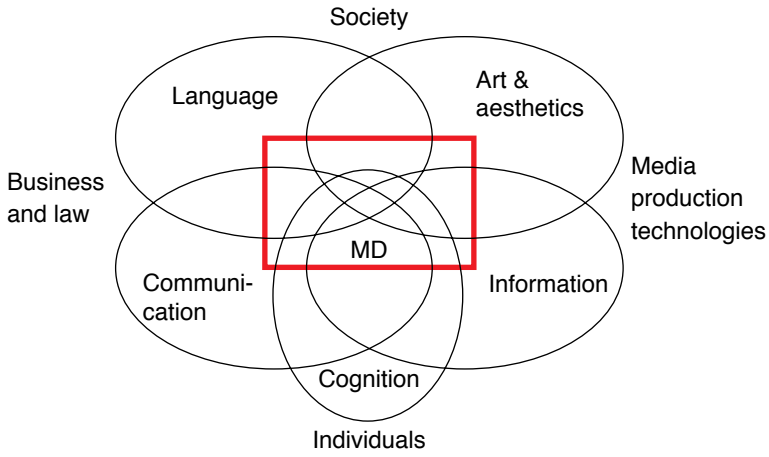

Figure 1. The message design model. Message design is interdisciplinary and encompasses influences and facts from more than fifty established areas of research (Pettersson, 2002, p. 9). In this theoretical model, main areas in message design (represented by a rectangle, MD) are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.The borders between the groups are rather blurred, unclear, and indistinct. Furthermore, the model is not intended to show any exact relationships between the different groups of the base disciplines.

Information design

Information design (Figure 2) can be hard to define, and it often goes by other names. Pettersson (1998, 2002) used the following definition: "In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message – its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements."

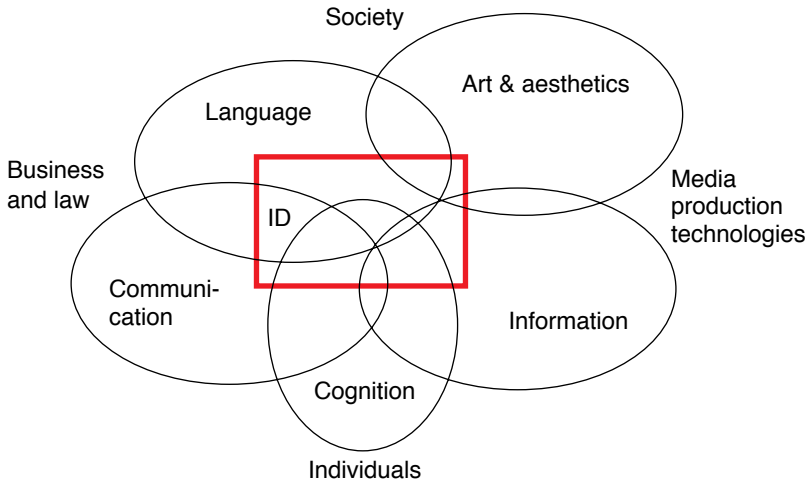

Figure 2. The information design model. Information design is interdisciplinary and encompasses influences and facts from more than fifty established areas of research (Pettersson, 2002, p. 19). In this theoretical model, main areas in information design (here represented by a rectangle, ID) are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.

Pettersson (2002, p. 17) noted that "A well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources." Information design has its origin and its roots (1) in *graphic design*, (2) in education and teaching, or rather *instruction*, and (3) in architecture and engineering, or rather *construction and production*. In these areas people have recognised the need for clear and distinct presentation and interpretation of verbo-visual information.

From a cognitive point of view, information design is less demanding than *instruction design*. In instruction design the receiver is to (usually) *learn* from the message. However, in communication design and in information design the receiver only has to be able to *understand* the message in order to use the information in practical situations. In many situations also learning is a result of this.

However, learning is usually not required in information design. *Persuasion design* comprises studies on different kinds of carefully planned information activities, where the goals are related to some kind of change in the behaviour of the receivers. Receivers are typically asked to *do something*.

Theory and practice

Like architecture, dance, economics, education, engineering, fine arts, journalism, medicine, music and theatre, *information design has a practical as well as a theoretical component*. Like the two faces of a coin, *infography* and *infology* are the two main parts of information design. As a discipline and an academic subject matter information design has three main areas of knowledge: infography, infology, and infodidactics (Pettersson, 2002, p. 20–21).

Infology

Infology is the science of verbo-visual presentation and interpretation of information. On the basis of man's prerequisites, infology encompasses studies of the way a verbo-visual representation should be designed in order to achieve optimum communication between sender and receiver (Pettersson, 1989, 1993).

Infology models contain both theoretical (descriptive) elements as well as normative (prescriptive) elements. Producers of information and learning materials can facilitate communication, and the learning processes of the readers.

Complicated language, in both texts and pictures, will impair the understanding of the message. Active voice, clarity, comprehensibility, consistency, legibility, precision, readability, reading value, simplicity, and structure are the key concepts in information design.

Any graphic message should be legible, readable, and well worth reading for the intended audience. Any audio message should be audible, distinct, and well worth listening to for the intended audience. The main goal in information and instruction design should always be *clarity of communication*. The presentations might also be exciting, aesthetically pleasing and visually rewarding.

Infography

Infography is the actual, practical formation and execution of structured combinations of text, pictures, and graphic design (Pettersson; 1989, 1993). The term infography was initially used mainly for information graphics in newspapers and television, but has since been used in a wider perspective for formation and execution of all kinds of verbo-visual messages used for the presentation of information in all media.

An *information designer* (or infographer) needs to have skills in writing comprehensible, clear and consistent texts, in creating clear illustrations, and in creating a clear, transparent typography and layout that aids understanding and learning (Pettersson, 1997).

The legibility of a graphical message is determined by the design of its text and pictures, as well as by their clarity. Usually a team of people with skills in the different areas are working together. The task is usually too overwhelming for a single person.

Art is valued for its originality and expressiveness. Its focus is on individual artefacts crafted through the manual and aesthetic virtuosity of the artist. Design, in contrast, is valued for its fitness to a particular user and to a particular task (Mullet and Sano, 1995, p. 8). Of course many designers may want to provide one or more aesthetic experiences where possible, but the design aesthetic is always related to the intended function of the information products intended for widespread distribution and use.

The creative processes (Figure 3) are influenced by *message design principles*, and are performed with *message design tools* suitable for the type of representation that has been selected. Message design principles can be seen as a set of guidelines for design and development of a verbo-visual message. Main creative processes for a verbo-visual message include the following four activities: ana-lysis and synopsis, production of draft, production of script, and production of original and master (Pettersson, 2002, p. 32). Each activity includes a review process. When the production is finished the final product may be evaluated.

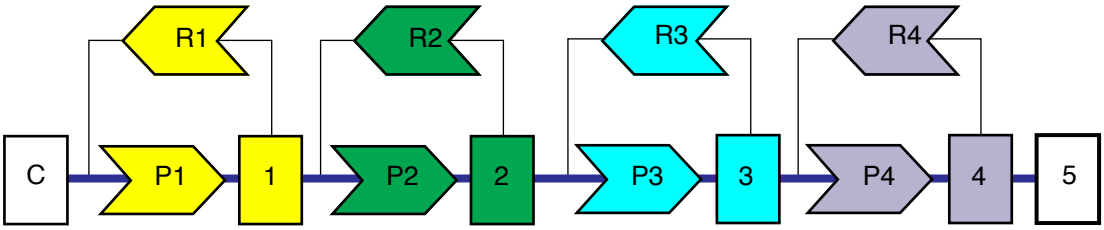

Figure 3. Creative processes include four different production (P) and review activities (R). The production activities are analysis and synopsis (P1) and synopsis (1), production (P2) of draft (2), production (P3) of script (3), and production (P4) of original (4) and master (5). C = commission.

Adams (1999, p. 19) concluded that it is a difficult task to design good information-giving materials. When faced with poorly designed information products the users still largely blame themselves. However, the quality of the information sets can be greatly improved by appropriate usability testing. According to Adams a push for a research-based information design must come from the

information designers. In each case members of the specific user group may be invited to evaluate preliminary texts and sketches for drawings and photographs.

Infodidactics

Infodidactics is the methods used for teaching the various aspects of information design. The huge spread among the different disciplines makes information design an interesting, but also a complex area of research and teaching. The goal of all scientific enterprise is *understanding*. When we understand a subject matter we are able to explain phenomena and predict new phenomena.

Although information design theories frequently refer to descriptive theory and propositions, their main function is to guide the information designers in how to actually design, present and produce information sets. In order to do this, it is important to work with problem-oriented learning in realistic projects; with existing and true problems, with regular "senders" or "information providers", with actual information materials, and with real "receivers" "information interpreters" that need the information. This also provides realistic experience with budget and time limits.

Areas of research

Information design studies is a broad area with contacts to several other areas of research. Many studies have mainly dealt with various aspects of verbal information in different media. Quite often pictures and images in the messages have been overlooked and "forgotten."

In my own work the goal has been to *study the presentation of visual and verbo-visual messages in information and learning contexts in order to gain a better understanding of the conditions related to the design, use, and interpretation of such information.* Most of my own work has been related to audience interpretation and perception of verbo-visual messages, to visual literacy and to the question of a visual language and its representations.

Areas of design

In information design it is always important that the intended audience will be able to understand the messages. The reader must always be able to distinguish between figure and ground without any trouble. Production of information materials is the opposite to camouflage, where the intention is to make a figure as much like the background as possible. At an oral presentation it may be better not to use any visuals at all than having to use low quality images.

Poorly executed and poorly presented images will influence the understandings of the whole oral presentation. Simple pictures are "immediate." They speak to us holistically and emotionally. When readers get the "wrong impression" it may be very hard to change this later on. A "design perspective" or "execution perspective" of message design and information design includes:

1. Text design
2. Image design
3. Shape design
4. Sound design
5. Light design
6. Spatial design
7. Time design

Types of content

It is important to understand the intended content in informative messages and information materials. What is the meaning with informative messages? What is the influence of culture? A "types of content perspective" includes:

1. Informative entertainment
2. Brief messages
3. Administrative documentation
4. Actual information
5. Instructions

Parts of communication

Information design encompasses studies of the way a representation should be designed in order to achieve optimum communication between the sender and the receiver. We can study the whole communications procecss, for example with respect to social aspects or "noise" in the system. We can also study the three distinct parts of the communications process. Each "part" can be divided in several sections:

1. The sender
   - Framing a verbo-visual message
   - Producing an original, master, and edition
   - "Sending" a verbo-visual message
2. The representation
   - Analyzing a verbo-visual message
   - Studying the relationships of the message

- Studying the development of new media

3. The receiver
   - Receiving a verbo-visual message
   - Understanding a verbo-visual message
   - Reacting to a verbo-visual message

Types of representations

A verbo-visual representation can be designed in different ways. Based on how the verbal information is presented to the receivers, we can distinguish three main types of verbo-visual representations (Pettersson, 1989, 1993).

We read the printed words in lexi-visual representations, such as messages printed in a book or messages displayed on a computer screen.

We listen to the spoken words in audio-visual representations, such as oral presentations with slides or overhead transparencies and in television programmes.

We read printed words and listen to spoken words in a combination of lexi-visual and audio-visual representations in multi-visual representations, such as interactive multimedia systems. Each "type" can be divided in several sections:

1. Lexi-visual representations
   - Manual productions
   - Technical productions
2. Audio-visual representations
   - Oral presentations
   - Recorded representations
3. Multi-visual representations
   - Interactive systems
   - Simulator systems

Message contexts

Factors inside the medium provide the inner context. The inner context is an internal context. In a book it is the relationship between various text elements, pictures and layout. We may also discuss the relationships between the image elements within a single picture.

The entire communications situation, i.e. senders and their intentions for the verbo-visual message, and receivers and their circumstances provide the social context. When we read a book or view projected images the lighting in the room may exemplify the close context. The close context and the social context are both external contexts. The context in which a specific message is pre-

sented has a major impact on the way that the message is perceived. A context perspective on information design includes:

1. The inner context
2. The close context
3. The social context

Research methods

To a large extent research in information design consists of applied research. Critically selected results from other research may often be used as a starting point. It is possible to create guidelines for the production of effective information and learning materials. Evaluation of the use of these materials provides useful information for further studies.

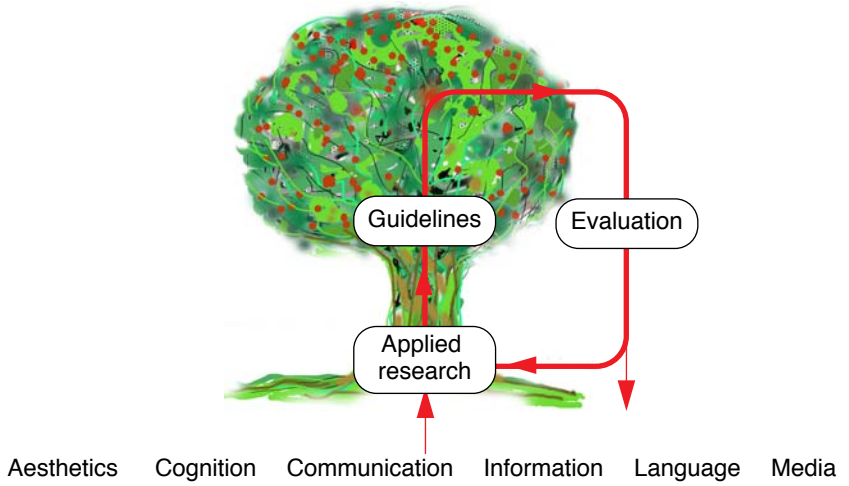

Figure 4. Applied research. To a large extent research in information design consists of applied research.

Quite often we need to disregard traditional praxis within the "base disciplines" and dare create new research methods that are exactly designed to fulfil the needs of the information design problem at hand. We need to be able to collect such data that are necessary to answer the research questions in each specific case. Obviously this may include certain risks and it may be rather complicated. However, it is necessary, in order not to get caught in dead ends.

As previously noted information design has a practical as well as a theoretical component. The same is true for disciplines architecture, dance, economics, education, engineering, fine arts, journalism, medicine, music and the-

atre. In all of these disciplines it is a major and difficult challenge to find a "good balance" between "theoretical work" and "practical work."

In order to distinguish between academic research and practical and artistic work in the design of artefacts Simon introduced the concept "science of design" in 1969 (Margolin, 2002, p.235).

Pettersson, Andersson and Olsson (2004) argued that if there is such a thing as a "common denominator" between theoretical work with academic research and practical and artistic work in the production of information materials this is probably *creativity*. Creativity is needed as the fuel for both processes.

We only need to study conference proceedings and journals in order to understand that researchers around the world are using a large number of different research methods in their research on language, art and aesthetics, information, communication, behaviour and cognition, business and media production technologies. Thus it is only natural to expect that several research methods are used in information design research, and Pettersson, Andersson and Olsson (2004) concluded that research in information design included many different research methods. Some are based on dedection, some on induction. Some research methods use qualitative methods, and some use quantitative methods.

Research in information design is a challenging occupation, partly due to this complexity. It has a pragmatic perspective on knowledge. New findings are tested and the results are confirmed in different situations and different environments. Each specific research problem needs its specific research method. Thus a process for research in information design always starts with an analysis of the problem or the situation (Figure 5). This sub-process is followed by project planning, study of literature, collection of data, analysis of data, interpretation and discussion, and publishing of the final report. A process for research in information design is the foundation for a certain stability and quality.

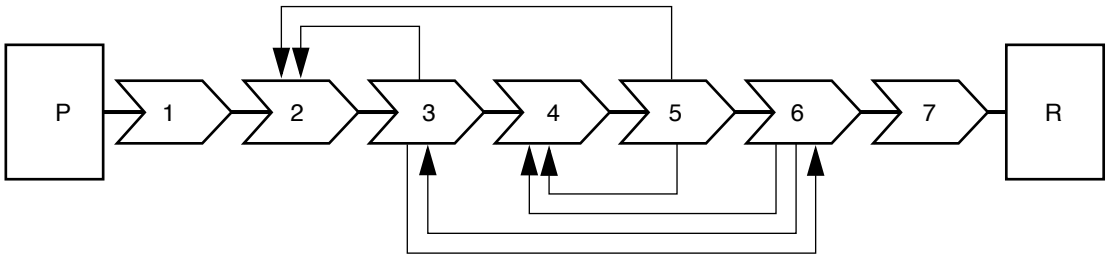

Figure 5. A process for research in information design. There are seven sub-processes between the formulation of a problem and the final report. These sub-processes are analysis of the problem, planning and manning the project, study of special literature, collection of data, analysis of data, interpretation and discussion, and publishing. Study of literature is a parallele activity throughout the whole research process.

Pettersson, Andersson and Olsson (2004) compared this theoretical research process with the practical production process in information design noted above in sub-section *Infography.* The comparison revealed that these processes basically include the same methods.

Nijhuis and Boersema (1999) made similar observations when they studied co-operation between researchers in behavioural science and graphic designers. They noted that it was not only possible to construct congruent strategic models of the two disciplines, but it was also shown that the corresponding tactics were remarkably similar. Differences in attitudes towards time and money only existed at the operational level, where specific skills and methods are used to achieve intermediate results.

Summary and conclusion

It may be concluded that the study of information design and the presentation of verbo-visual messages is a multi-disciplinary, multi-dimensional and world-wide consideration. Information literacy, visual language, visual literacy, perception and learning are important concepts. We should not only use one or a few accepted research methods in information design. We should use the research methods that are needed in order to answer the research questions in each specific case.

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Paper 6

Literacies in the new millennium

Abstract. *This paper includes a discussion of literacies in the new millennium. Reading and writing means more than recognizing words; it also implies comprehending the meaning of the words that we read or write. Today the concept of literacy is much broader. A person may be computer literate, culturally literate, economic literate, film literate, information literate, media literate, political literate, scientifically literate, technically literate, television literate, video literate, and visually literate. Consequently a person may be illiterate in all these aspects.*

In the industrialized, cultural sphere, we are bombarded with information via the media, at home, in school, at work, and in the society in general. It is difficult at times to avoid information and it may be just as hard to obtain the information that we really need at the time. Audio, text, and visuals compete for our attention. It is quite possible that we miss the information in which we are really interested. In addition to radio, television, books, newspapers, and magazines, vast amounts of information are distributed in the form of advertising throwaways, posters, placards, and photocopies.

Throughout the 1980s, major changes occurred in the way our society produced, stored, and accessed information. Monfils (1993) concluded that regardless of the specific application of technology, consensus had been reached on the increasing impact of modern information technology on all aspects of our lives. Modern research and development produce more information than ever before and people frequently find that their knowledge is inadequate and fragmented.

Traditionally, the concept of *literacy* was restricted to the state of being *literate*. A *literate person* is one who is able to *read and write printed text*. Consequently, an illiterate person is unable to read and write. However, reading and writing means more than recognizing words; it also implies comprehending the meaning of the words that we read or write. During recent decades, however, people have recognized the need for a wide array of other "literacies" rather than a singular "literacy", based on the traditional medium of print. Beyond the basic skills of reading, writing, and arithmetic, the citizen of the twenty-first century needs complex analytical skills.

The tools of the Information Age have put vast volumes of information at our fingertips. According to Scott, Kirsch, and Jenkins (1998, p. 17) the Adult

Literacy Survey (IALS) defined literacy as "using printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential". Hugo and Skibbe (1991) argued that the illiterate of the future might not be those who cannot read, but those who cannot see.

Today the concept of literacy is much broader. Other literacies are computer literacy, cultural literacy, diagrammatic literacy, document literacy, economic literacy, environmental literacy, film literacy, information literacy, mathematical literacy, media literacy, music literacy, political literacy, scientific literacy, technical literacy, television literacy, video literacy, and visual literacy. Thus a person may be computer literate, culturally literate, diagrammatic literate, economically literate, environmentally literate, film literate, information literate, mathematically literate, media literate, musically literate, politically literate, scientifically literate, technically literate, television literate, video literate, and visually literate. Consequently a person may be illiterate in all these aspects, which would be hard in our modern society. We have, and indeed we fail to have many different literacies. Erstad (1998) pointed out that we need to abandon the notion of literacy as a set of disembodied "skills" and to recognise that literacies are always inevitably situated within specific practices and specific social contexts, what some educators term a social theory of media literacy. Information literacy is a potential tool of empowerment for all.

Computer literacy

Considine and Haley (1992) argued that computer literacy clearly relates both visual literacy and media literacy to the traditional concepts of literacy, namely reading and writing. Monfils (1993) argued that to be computer-literate one needs only be a computer user, not a computer programmer. It is, however, not always easy to be a computer user. Sterner (1997) noted that users of all kinds of appliances often expect to be able to use the specific appliances without first reading any instructions for use at all. When people fail and realize that they need instructions for use they expect to be able to follow a clear text with pictures, and a well developed index, as well as a trouble-shooting guide. This however, is usually not at all the case. Instruction manuals may be hard to understand and they do not always meet even modest quality expectations.

Modern computer systems often have user interfaces based on symbols intended to function in various countries, in various cultures and subcultures. These symbols may, however, actually not function at all for the intended users. Griffin et al. (1994) studied how international business people interpreted and understood commonly used clip art graphic symbols. The symbols were taken from a Harward Graphics software package for business presentations. Based on 4,530 opinions expressed by 302 subjects in Japan, Sweden, Tanzania and

the USA, regarding 15 of the symbols in the software package, Griffin et al. made the following two conclusions:

- There are many ways to interpret symbols. Very few people share the same understanding of any given symbol.
- There are strong cultural differences in interpreting the meanings of symbols.

Computer users should not be satisfied with the present situation. Users should demand better graphical interfaces as well as better instructions for use. Better user interfaces would probably fast increase the number of computer literate users.

Environmental literacy

Environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain, restore, or improve the health of those systems (Roth, 1992). Levels of literacy are generally assumed to exist but are not often defined. With respect to environmental literacy , Roth proposed the identification of three levels:

- *Nominal*, indicating ability to recognize many of the basic terms used in communicating about the environment and to provide rough, if unsophisticated , working definitions of their meanings.
- *Functional*, indicating a broader knowledge and understanding of the nature and interactions between human social systems and other natural systems.
- *Operational*, indicating progress beyond functional literacy in both the breadth and depth of understandings and skills.

These three levels of literacy; nominal, functional, and operational, could also be used in other literacies.

Information literacy

From a terminological point of view the concept “information” may be placed somewhere between the concepts “data” and “knowledge”. It is not easy to draw strict borderlines between these concepts. We may view information from various perspectives with respect to how we create, present, produce, distribute, search, sort, index, store, receive, process, value, respond to, make use of, and renew information. Often several groups of people with different skills are

needed for these activities. Each person has a set of individual experiences and values which will influence their view of information. Vickery and Vickery (1987) pointed out that information is a merchandise, however quite different from other kinds of commodities. They wrote (p. 27):

> Information is a peculiar commodity. When transferred from source to recipient, or from seller to buyer, it remains available to both. Unlike the sale of a material product, information transfer does not give the recipient the right of exclusive use, ...

Most people are involved with communication and with communication systems in one way or another. Some of these systems have "soft" and human or linguistic dimensions. Other systems possess "hard" and technological dimensions. Within library and information science some research areas are well established since many years. Other areas are relatively new and can be regarded as independent scientific disciplines. In several instances certain issues are addressed in different disciplines, even if the approaches may vary.

Research in library and information science (Höglund, 1995) emphasizes the conveying of information and culture that is stored in any kind of document. Research projects range from historical and social aspects of information, to modern information technology like multimedia, the World Wide Web (WWW), and other information tools on the Internet. In WWW several "home pages" include graphics and image maps with hyperlinks to related information. Image maps range from very simple to very complex, from simple schematic pictures to works of art. Many information studies have mainly dealt with various aspects of verbal information, such as classification, indexing, cataloguing, storing, and retrieval of text. However, the visual image has occupied a central role in human communication, and in documents, since the dawn of civilisation. Harrison (1981) noted that pictures are sources for information (p. 3):

> A picture is a source of visual information. It may be a photograph of a work of art or it may be a work of art itself, but in library terms it is a piece of information to be used and evaluated as any other information available in the library. The information contained in a picture may be taken from life, of geographical features, scenery, street scenes, natural phenomena, animals, people, or activities, or a direct presentation of a work of art.

In the USA, the *American Library Association* (ALA, 1989) defined information literacy as follows (p. 1): "To be information-literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." The same year, a *National Forum on Information Literacy* was established in the USA as an umbrella group for national organizations committed to helping people become effective consum-

ers of information. This group wants to show that literacy can no longer be considered merely to be the ability to read and memorize a base of knowledge; instead, literacy must entail the ability to acquire and evaluate the information that is needed in any situation. According to Senn Breivik and Jones (1993), society has reached the point where the traditional literacies sought by liberal education are insufficient (p. 26): "Higher education is being called upon to define and develop a new learning style that fosters within students the abilities needed to be information-literate".

Doyle (1994) defined information literacy as "the ability to access, evaluate, and use information from a variety of sources". She created a list of characteristics of an information literate person. An information literate person has *information competence*, and accesses, evaluates and uses information in a qualified way. In accordance with Doyle an information literate person is one who:

- recognizes that accurate and complete information is the basis for intelligent decision making
- recognizes the need for information
- formulates questions based on information needs
- identifies potential sources of information
- develops successful search strategies
- accesses sources of information including computer-based and other technologies
- is a competent reader, evaluates information, and determines accuracy and relevance
- recognizes point of view and opinion versus factual knowledge
- rejects inaccurate and misleading information
- organizes information for practical application
- integrates new information into an existing body of knowledge
- uses information in critical thinking and problem solving

Doyle (1994) concluded that as American society has shifted from an economy based on capital goods (industrial) to an economy based on services (information), there has been a corresponding shift in what is expected from American education. Knowing how to ask the right questions may be the single most important step in learning. The process that is conducted in order to find answers to the right questions leads to the point at which information becomes knowledge. Information literacy is central to all successful learning and by extension to all successful living. All of us face an information-rich future in which change will be one of the few constants of our life experience. The ability to adapt and fulfil our individual potentials will require us to be life-long learners and independent decision-makers. In Canada the *Association for Teacher-*

Librarianship in Canada (ATLC, 1995) has developed a "students' bill of information rights". According to this bill students in Canada should have the opportunity to:

- master the skills needed to access information in print, non-print and electronic sources;
- understand and master effective research processes and reporting skills;
- develop the ability to evaluate, extract, synthesize and utilize information from a variety of sources and media;
- utilize data and information to expand their own knowledge base;
- explore the creative use of information;
- develop an understanding of our Canadian cultural heritage and history, as well as cultures and histories of other societies;
- enhance their own self knowledge through developing a love of reading;
- explore the values and beliefs of others by reading world literature;
- think critically, and make decisions based on personal needs and values as well as upon factual evidence; and
- actively participate in decisions about their own learning.

Since information is a vital component in the development of critical thought and independent decision-making, access to the ever-increasing body of available information is vital to the development of students' potentials. Furthermore the *Association for Teacher-Librarianship in Canada* believes that all students should have the right to:

- access a wide range of print, non-print and electronic learning resources at an appropriate level;
- explore materials expressing a variety of opinions and perspectives; and
- freely choose reading, viewing and listening materials for recreational and study purposes.

This kind of "students' bill of information rights" should be extended to "all people". In an information society, everyone should have the right to access needed information. Even if most people may be able to distinguish the sometimes biased opinions presented by some media, not all, in fact, are able to find the objective information that they really need. We need to learn to locate, access, evaluate, process, understand, and use information. We need to learn to handle various new situations in this age of information. Information literacy skills will be needed as a foundation for democracy and democratic societies.

As previously notet information literacy is a potential tool of empowerment for all. Information literacy programs encourage shifts in the roles of teachers and learners. In an information literate environment, students engage in active,

self-dirfected learning activities, and teachers facilitate student's engagement through a more adventurous style of instructional delivery (Hancock, 1993).

Media literacy

Sutton (1992) noted the similarities between information literacy, media literacy, and visual literacy. Traditional literacy is not enough anymore. In a discussion on the evolution of imagery technologies, Fredette (1993) cited Loveless (1992), who wrote about the evolution of media technologies and identified their changing effects on consciousness, and their parallel role in redefining the traditional concept of literacy. Loveless suggested that the children of the future will need to be literate in both "data in motion" and "images in motion". According to Loveless the latter means being literate in the language of photography, film, video and satellite communications. Obviously, a modern definition of literacy must include much more than traditional reading and writing.

Considine and Haley (1992) argued that media literacy helps students to recognize, read, comprehend, and question ideas and information, whether conveyed to them through printed media or other media formats. Media literacy may be defined as the ability to access, experience, evaluate and produce media products. The main principle of media literacy is that media *represent* actual events. Journalists select which stories to tell, what to tell, and how to tell them. There is always one or more persons with their subjective views behind all representations. Each medium has unique aesthetics, codes and conventions. People have to learn how media are made and how they function. Each person bring her or his own experinces that affect the understanding of the representations. Individuals from different age groups, backgrounds, and cultures will understand the same message differently (Pettersson, 1996). Erstad (1998) discussed media literacy among children and he noted that the concept of media litercy enables us to get away from behaviourist notions about what the media do to children and move towards social-constructionist perspectives regarding children as active, competent users of television, film, video and computers. Today, curricula for media education have been developed in many countries. There are also teaching aids, like books and videocassettes. Key concepts of media education include questions like:

- Who is the sender?
- Who is the receiver?
- What type of message is it?
- What type of media are used?
- How is the message produced?

- What kinds of technologies are available?

The pace of development of information technology is likely to increase rather than decrease in the future. It is possible that visual messages, and verbo-visual messages, in varying forms will become increasingly important.

Enser (1995) noted that we now belong to a society experiencing technological advances which are serving to promote the importance of the *visual medium* for message transmission and knowledge representation. I agree with Enser that this is a paradigm shift offering both opportunities and challenges, especially for the education and information professions. I also foresee two other paradigm shifts. In the future we will focus on the *information content* rather than on the documents as such. We will also see a shift from emphasis on teaching to *emphasis on learning*. In this context it may also be noted that Malmberg (1996) pointed out that the culture industry transforms pleasure into mere entertainment and a *society of entertainment* is emerging.

Television literacy

In accordance with Gray (1989), the Department of Education in the USA has defined CTVVS, Critical Television Viewing Skills, as "those factors which enable persons to distinguish among a wide range of programme elements so they can make judicious use of their viewing time." The essential competencies of critical television viewing skills are:

- to understand the psychological implications of commercials
- to distinguish fact from fiction
- to recognize and appreciate differing or opposing points of view, or both.
- to develop an understanding of the style and content of dramatic presentations, documentaries, public affairs, news, and other television programming
- to understand the relationship between television programming and the printed word

Gray concluded that programmes for critical television viewing skills can successfully be integrated into the elementary and secondary school curricula. In accordance with Gray, it would be possible for the teachers to educate critical consumers of television, as well as critical consumers of literature.

In Sweden Findahl and Höijer (1979, 1980, 1984) demonstrated that radio listeners and television viewers sometimes had great difficulties in comprehending broadcasted news. The news content was badly organised, and the language was complicated. Critical television viewing skills could also be called "television literacy".

The term television literacy has been widely used in recent years, both by researchers and by educators. The program *Media Literacy: Teaching about Television* by *Teaching for Results* touch on the following three key concepts of television literacy (Media Literacy, 1998):

1. *Television is an artificial construct.* Television does not present a reflection of reality; rather, its images are representations of reality. Television has its own conventions, its own grammar; the success of a television production depends on how carefully it is crafted.
2. *Television has commercial implications.* Television is a profit-centred enterprice. Programs are judged by the size of the audience they generate and by the market they offer the advertiser. Programs that do not turn a profit – educational fare, documentaries, civic forums – inevitably lose out to enterrtainment programs that do.
3. *Television is the prime conveyor of popular culture.* Television narratives convey a number of implicit and explicit ideological messages; these messages suggest what and who is important, and are generally representative of the values held by the dominant groups in society.

Buckingham (1993) argued that the notion of television literacy is far from straightforward in the present discussion. Television literacy begs many theoretical questions, and can be defined in many ways. Buckingham sees television literacy mainly as a powerful metaphor.

Diagrammatic literacy

Allmendinger (1998) argued that people use the same high level skills when they read diagrams as when they read prose. Reading diagrams involves perception, domain knowledge, narrative, motivation and bias, as well as social consensus. Diagrams are visual models, They depend on point, line, plane, volume, value, colour, and texture, as well as text. Each visual element corresponds to something in the real world. Relationships between visual elements in a diagram mirror relationships between objects in the world.

Coll, Coll, and Thakur (1994) compared graphs with tables. They found that business students performed more accurately with tables, and engineering students performed mor accurately with graphs. The business students were faster and more accurate than the engineering students. However, both groups preferred tables. According to Allmendinger (1998) diagrammatic literacy is a matter of getting people to make better decisions based on fairly sophisticated graphics information. Lowe (1993) found that experts and novices apply different mental strategies when they read diagrams. The experts base their interpretations on underlying principles and domain based categories. Beginners,

however, rely more on visual patterns in the diagrams. So far there are no universal conventions for diagrams.

Visual literacy

Although the term "visual literacy" may be modern, it is not at all a new idea or a new concept. Discussions about the use of images and pictures have a long history. Ancient philosophers used images for visual communication. In anatomy and medicine, Aristotle employed anatomical illustrations. In mathematics, Phythagoras, Socrates, and Plato used visual images to teach geometry.

Jesus Christ and other religious educators and prophets helped their listeners create inner images by means of different metaphors. In Mesoamerica, the old cultures and civilizations used advanced pictorial messages, especially in their temple cities.

Visual literacy is a broad and interdisciplinary concept including theoretical perspectives, visual language perspectives, presentational perspectives, technological development, and bits and pieces from several other "established fields" of research. Despite all the efforts during the past 30 years visual literacy and the "visual literacy movement" has not been able to attract enough interest from society and from those responsible for school curricula. An important reason may be a general lack of focus.

Definitions of visual literacy

There has been, and there still are considerable disagreements concerning a definition of visual literacy. It is clear that it is difficult to describe verbally a concept that is primarily nonverbal. Over time, definitions have varied from very narrow to very broad explanations of greater or lesser complexity. A number of researchers have practically rejected the whole concept of visual literacy.

Heinich, Molenda, and Russell (1982) recognized that there are different aspects of visual literacy. They compared visual literacy with print literacy and offered the following definition (p. 62): "*Visual literacy* is the learned ability to *interpret* visual messages accurately and to *create* such messages. Thus interpretation and creation in visual literacy can be said to parallel reading and writing in print literacy. " In my opinion this is a very good definition of visual literacy. The definition reflects the perspective that visual literacy is a concept in which particular skills, knowledge, and attitudes can be taught and learned, which enhance our abilities to communicate.

The International Visual Literacy Association, IVLA, was established as a non-profit association in the State of New York in 1968 to provide a multi-disciplinary forum for the exploration, presentation, and discussion of all aspects

of visual communication and their various applications through visual images, visual literacy, and literacy in general. IVLA serves as the organizational base and communications bond for professionals from various disciplines who are interested in visual literacy. IVLA provides the following four "official definitions" of visual literacy (printed on official leaflet, 1989):

1. A group of vision competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences.
2. The learned ability to interpret the communication of visual symbols (images), and to create messages using visual symbols.
3. The ability to translate visual images into verbal language and vice versa.
4. The ability to search for and evaluate visual information in visual media.

The bulk of all visual literacy research has been done with learning and instruction in mind.

Visual languages

To be able to produce an effective visual message it is important to understand the characteristics, possibilities, and restrictions, of visual language and of the actual pictures. We need to know how visual languages are constructed, perceived, and differ from verbal languages. Several variables in visual language are noted in the following sub-sections: (1) Visual content, (2) Execution of visuals, (3) Context, and (4) Image formats.

Visual content

Messages including visuals are preferred by most subjects and attract attention. Generally speaking, humans, especially their faces, are the kind of content that will get maximum attention in images. It is also known that objects and pictures of objects are remembered better than their names. Structure of content, factual content (objects, time, place, and statistics), events (motion, sound, humor, and relationships), emotions, credibility, symbolism, and viewer completion are examples of variables related to visual content.

It is important to define how the illustrations may be used. The most important factors seem to be information and learning objectives, and user characteristics. In some situations pictures may be distracting, and should not be used at all. Visuals must always be relevant to the situation. Without clear content, a visual will not be able to function well. What information or knowledge is the visual intended to convey? Who is the sender? Who are the receivers? And in which medium or media is the visual to be distributed? Cues for understanding the message in a visual are different in various cultures as well as in different socioeconomic groups.

Execution of visuals

Informative pictures should always be designed so they are easy to read. The goal should be *clarity of communication*. Several authors have pointed out that *"form follows function"*. Industrial products are often shaped by what they do. To make everyday life easier we want to have products with as good function as possible. However, in *message design* the subjective tastes of the individual designers are often allowed to dominate, sometimes with a serious malfunction as a result.

Picture type (drawings, paintings, photos, etc.), size, shape, colour (hue, value and saturation), contrast, texture, light and shadows, emphasis, composition, perspectives, technical quality, texts in pictures, pace, speed changes, editing, zooming in, zooming out and panning are examples of factors related to execution of visuals.

An artist or a painter producing a picture may use lead, crayons, India ink, various kinds of paint, paper, canvas, and several other kinds of material in a variety of different combinations. The image is gradually produced by combinations of dots, lines, and areas. The actual picture is built up from materials and pigments which, according to intentions, can be completely separated or gradually mixed. In computer-based systems *bit-mapped pictures* consist of picture elements defined by their positions, and *object oriented pictures* are defined by algorithms.

Context

A verbo-visual message has both internal and external contexts. Factors inside the medium (internal) provide (1) the *inner context* such as text, speech, music, sound effects, or other visuals. Our attention is on either the sound or on the image when we view a film or a TV program. This is even more obvious when we look at a multi-image slide and film presentation. As soon as the film starts, our attention is directed towards the movement in the film from the surrounding stills. It is just impossible for viewers not to be influenced by the film.

When we read a book or view projected images the lighting in the room may exemplify (2) the *close context*. In an oral presentation the audience is influenced not only by the presenter and her or his projected images but also by the temperature, the furniture, the room itself, outside noise, noise from the projector , and noise from other persons. The lighting conditions may be the most important variable for our perception of all kinds of images. A projected image is perceived as having high image quality in a dark room. When the light increases, the perceived quality decreases. A printed image is perceived as having high image quality in a light room. When the light decreases, the perceived quality decreases.

The entire communications situation, i.e., the senders and their intentions for the verbo-visual message, and the receivers and their cultural, economical and social circumstances provide (3) the *social context*.

The close context and the social context are both *external contexts*. The context in which a message is presented has a major impact on the way the message is perceived. Perception of brightness, colour, size, shape, pattern, and motion have all been shown to be influenced by contextual variables. One and the same visual may be perceived in different ways in different contexts. A single picture from a series may be hard to decipher, but the visual's content becomes easier to comprehend when that picture is returned to its proper sequential context.

Image formats

Our perception of a visual is affected by its medium, e.g., as a photograph, a printed image, a slide projected on a white screen, and a computer-generated image. A movie evokes different perceptions when a viewer watches it alone on a TV-set, or in a crowded movie theater with a wide-screen and high-quality sound and images. An image is a multidimensional representation of an inner or an external reality, depicting the physical structures of the objects or events it represents.

Mirror images and other virtual images, created by mirrors, lenses, and other optical systems, can be seen but not "captured" and shown on a screen of any sort. A virtual image is located at a point from which divergent light beams seem to start before they have passed the optical system. Like our inner images, e.g., memories, virtual images lack an obvious physical format. All other kinds of images have a physical format.

In technical systems the whole motif may be captured at once with a traditional camera, or it may be scanned line by line with a TV-camera. Except for the printing of line drawings, all other pictures have to be divided into small elements, picture elements, or pixels, in the technical process of duplication. The image has a vertical (y) and a horizontal (x) resolution, and it has also a "depth resolution" (z). An individual pixel may vary with respect to shape, size, position, value, grain, colour, and grey scale. Normally these pixels are very small. At normal reading distance they can hardly be seen. In fact *an image with good quality must have a resolution that is better than that of our own vision*. It takes time to read an image. This *inertia* enables us to see the motion in the stills which comprise movie film and television.

Visual literacy skills

Debes (1969) identified 35 visual literacy skills. These range from the ability to distinguish light from dark to the ability to read and express a sequence of body language arranged to express a personal emotion. Partly based on these skills Avgerinou (1997) is developing a test for visual literacy skills. In the work of

Fransecky and Debes (1972) the objectives for the visually literate student are (p. 12):

- To be able to read visuals made for intentional communication.
- To be able to plan visuals for intentional communication.
- To be able to create visuals for intentional communication.
- To be able to combine visuals and verbals for intentional communication.

Thus, according to Fransecky and Debes, the competencies of visual literacy are defined as *reading, planning* and *creating* visuals, and *combining* visuals and verbals for intentional communication.

Esdale and Robinson (1982) argued that visual literacy should be integrated across all curricular areas in an effort to both expand ability and to prevent categorization which could limit learning and the use of visual literacy skills.

Schiller (1987) argued that all the different viewpoints of visual literacy show that every visual medium has its own characteristic form. Thus, there are clearly different visual literacies, and there are different skills to be learned in terms of their characteristic techniques and methods of expression. As a consequence people should concentrate on more limited concepts, such as computer literacy, film literacy, video literacy, and television literacy. Indeed, it might be impossible to create one single definition of the broad concept of visual literacy. Hanson, Silver and Strong (1988) argued that the skills and understanding of visual literacy are not taught in schools in any organized way. However, these skills are directly related to academic success, and especially to success in reading. According to Hanson et al. the successful student can (p. 285 – 286):

1. Recognize instances of the same element in different contexts.
2. Produce graphic likeness.
3. Recognize an object when seen from different angles.
4. Transform one element into another by imagining movement, rotation, inversion, or internal displacements among the parts.
5. Identify or correctly configure elements within a spatial configuration which could otherwise represent distortions because of the observer's orientation.
6. Identify lines of force, tension, balance, and composition so as to identify the principles that make the visual arts aesthetically satisfying.
7. Identify resemblances, symbols, or signs across seemingly unrelated areas of existing knowledge or personal experience.

Whiteside (1985) discussed visual literacy awareness in college-level educational media courses. He used a seven-step approach to plan and implement visual literacy modules:

1. Defining visual literacy.
2. Identifying visual literacy needs.
3. Selecting and prioritizing needs, goals, and objectives.
4. Selecting appropriate media.
5. Planning classroom activities.
6. Implementation of visual literacy modules.
7. Planning for future activities.

Considine and Haley (1992) noted that the effective integration of imagery into instruction can facilitate the student's ability to read, recall, and comprehend the content of the message. Visual literacy can therefore support traditional literacy. In cultures where magazines, newspapers, film, television, and video proliferate the natural learning of visual literacy becomes incidental and develops over a long period. In fact this learning may never occur.

In South Africa deLange (1996) proposed that adults in developing countries, that are not exposed to a visual culture as found in North America and Western Europe, might never develop a basic ability to read pictures. Their frame of reference and their level of understanding could possibly extend only to the limited number of visuals that they have actually been in contact with. Thus, it may not be enough to merely modify visuals in print media for these cultures. In many situations new pictures may be needed. Schiffman (1995) studied information design guidelines for designing and evaluating visual components of educational materials for ethnic populations within the USA. She concluded that it is necessary to adopt visual messages to various ethnical groups (p. 76): "Visually translating health educational materials will be critical to the success of communication efforts, particularly as our population continues to change ethnically and less developed countries continue to develop."

Information design

The various literacies and modes of thinking required in an information society will challenge the capacities of every person. While a variety of means are being found to help build and maintain these information resources, new vistas of capacity lie before us. These opportunities, and how we respond to them will determine our collective future in a world society grown closer through mutual dependence upon shared intellectual resources. Beyond traditional literacy is information design.

In the age of information we have an ever increasing need for computer interfaces, educational materials, exhibitions, forms, graphic symbols, instructional materials, learning materials, lists, maintenance information, manuals, non-fiction books, on-line help for managing computer-based systems, procedural aids, product descriptions, public information signs, reference books, road traffic signs, system descriptions, tables, technical reports, tickets, webpages, and other kinds of information materials. These are examples of *information utility goods* that we need to perform our tasks at work. We also need an increasing amount of information materials during our leisure time, in order to be able to handle things like new cameras, cars, CD-players, computers, computer software, etc.

Thus well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources.

Marsh (1983) discussed the term *communication design* for "messages that work." He made a clear distinction between an *artistic approach* and a *design approach*. These two approaches differ in their goals. Marsh commented that the artistic approach strives for *perfection*, while the design approach strives for *workability* in a cost effective context. The design approach minimizes the need for rewriting and editing by careful planning of the work. The two approaches result in vastly different final products. The artistic approach tends to judge success by whether the product feels right and whether the critics like it or not. The design approach judge its success by whether the product achieves the objectives as specified by measurable performance objectives, within the specified resources and situational constraints. In addition the School of Design at Carnegie Mellon University (1997) has defined communication design "as the effective presentation of ideas and information by means of type and image, whether in the traditional medium of print or in the new digital medium that supports interactive computer displays, multimedia communication technology, and information systems." Also here the focus is on *workability.* Wileman (1993, p. 6) noted that: "Communication can be judged successful only when it conveys the information it sets out to convey. This is as true for visual modes as it is for verbal modes." Also Brandt (1997) provided a practical, workability and useability view related to information utility goods, and defined information design as "the ability to search for information, make choices, create and package information." He further remarked that "the message must reach the receivers in a proper way." A well designed information product will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. Mullet and Sano (1995, p. 2) remarked that: "The goal of communication-oriented design is to develop a message that can be accurately transmitted and correctly interpreted, and which will produce the desired behavioural outcome after it has been understood by its recipient." Pettersson (1996, 1997) provided a pro-

cess-oriented workability and usability view of communication, and discussed message design principles as well as message design tools.

On its WWW-homepage the *International Institute for Information Design* (IIID) defines design in the following way (1997): "Design is the identifying of a problem and the intellectual creative effort of an originator, manifesting itself in drawings or plans which include schemes and specifications." And information design: "Information design is the defining, planning, and shaping of the contents of a message and the environments it is presented in with the intention of achieving particular objectives in relation to the needs of users. At this point of the development IIID is concerned with the design of visual information but it could in the future include the design of information other than visual one." These two definitions were recommended by the 2nd IIID Conference in 1994. They have also been published in several issues of the *ID News*. The main concern of the IIID is to contribute to a better understanding within the human community with respect to cultural and economic issues by means of improved visual communication. IIID is supported by UNESCO (1995), and endeavours to develop information design as an independent interdisciplinary field of knowledge and professional activities.

Thus information design is indeed an interdisciplinary field of knowledge, and as far as I have been able to find out it encompasses influences and facts from more than fifty established disciplines and areas of research. In this paper the main areas of research are divided into the following six groups. It should, however, be noted that other groupings are also possible.

1. *Language disciplines* such as drama, graphic design, linguistics, rhetoric, semiology, verbal languages, and visual languages. (Graphic design is often seen as an art subject. However, from an information design perspective the language aspects of graphic design are more important than the art aspects.)
2. *Art and aesthetic disciplines* such as aesthetics, computer graphics, film and cinema, illustration, photography, television and video.
3. *Information disciplines* such as computer science, information processing, and information science.
4. *Communication disciplines* such as communication theory, information technology, information theory, media studies, instructional technology, instructional design, instructional message design, journalism, and planned communication.
5. *Behavioural and cognitive disciplines* such as cognitive science, didactics, information ergonomics, pedagogy, psychology, sociology and their subareas. The study of attention, perception, cognitive skills, and memory are especially important. Some aspects deal with individuals, and some with the societies in which we live.

6. *Business and media production technology disciplines* such as business economics and management, information economics, information management, law, and various technologies for production and distribution of different media.

Thus information design does not primarily include areas like advertising, entertainment, fine arts, news or propaganda. Tufte (1990) noted that the principles of information design are universal, and are not tied to unique features of a particular language or culture. And IIID (op. cit.) noted that: "Special attention is paid to the potential of graphic information design to overcome both social and language barriers". The study of information design can be summarized as a multi-disciplinary, multi-dimensional and worldwide consideration.

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Paper 7

Comprehensibility

Some people are continuously in the process of creating documents, such as PMs, messages, instructions, reports, descriptions and course literature. Some of these documents are meant only for distribution within limited groups, while others will be spread to many different readers both inside and outside the company. However, because any author's intended message may be interpreted in different ways by different readers, problems arise. In some cases, readers do not understand the documentation at all.

It is difficult to create easily understood information. On the other hand, it is simple enough to require ease of comprehension. But what is actually implied when we say that a message is comprehensible?

To someone working with information, it is not sufficient that a message be produced and transmitted, as in radio and TV, nor is it sufficient that a message be produced, transmitted and received by an audience. The act of communicating is not complete until our message has been both received and understood by the audience. In other words, our messages must always be comprehensible, otherwise they will have no effect.

Communication

Communication takes place when a sender wants to convey one or more messages to one or more receivers. The sender transfers the messages to the receivers with the help of different media. A medium and its contents (the message) constitute a "representation". In this report, I shall focus on formulating the message. As the reader will see, the discussion of comprehensibility is fundamentally applicable to all media. On occasion, unfortunately, communication does not seem to function. This may depend on insufficient information, but it may also be because we have difficulty reaching each other. By way of example, the following title is cited as a warning in "The Technical Writer's Handbook" (pg. 206) by Matt Young:

> Conditional symbolic modified single-digit arithmetic using optical content-addressable memory logic elements: Conditional symbolic modified signed-digit arithmetic operators.

Esoteric and impenetrable jargon like this can be perceived as incomprehensible by the uninitiated. Since readers who do not know the code are left out, its use poses the risk of "one-way only" communication, and has no value outside of initiated circles. We find it unsettling when experts speak down to us; it puts us into a defensive frame of mind, and may even cause us to become obstinate. Interaction analysts describe this as a "You're OK, I'm not OK" reaction. However, what we should be striving for is a "You're OK, I'm OK" situation.

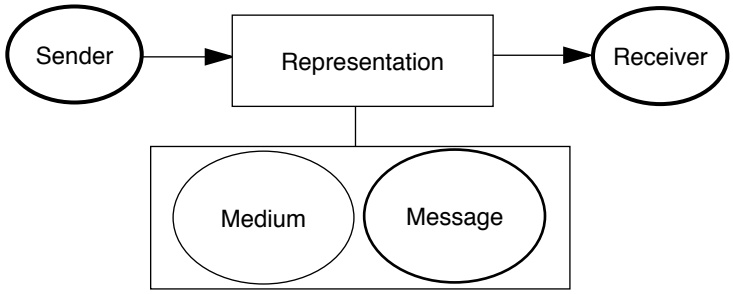

Figure 1. A "representation" is a medium with a specific message. The sender transfers his message to the receiver with the help of a medium.

When a document is to be read and understood by several people, there is ample reason to expend effort on achieving a good quality of information. When this is achieved, we can discern the information's esthetic, informative, pedagogical and technical qualities, and sometimes even its entertainment value. Good information quality can be defined as the degree of congruity between the sender's and the receiver's subjective perceptions of the information, as well as of the reality that the information represents. By investing resources in improving the quality of information, we can achieve better product and project quality, while at the same time making large cost savings. It seems as though arcane, abstruse texts have become a global problem in technical and scientific documentation. Kirkman (1992) opens the first chapter of his book "Good Style" with the following two paragraphs (pg. 2):

> It is surely axiomatic that the aim of technical writing is to transmit information accurately, quickly and economically from one person to another. Then why do so many scientists and engineers make their writing so heavily unreadable?
> Obviously, their subject matter is sometimes complex and conceptually difficult; but frequently the 'unreadability' stems from the use of a style that makes the reader's task much heavier than it need be."

Good documentation implies very good comprehensibility and low cost, as well as ready accessibility when it is needed — and only then, in fact. Poor compre-

hensibility causes the receiver's confidence in the sender to diminish, and heightens the risk of unsound decisions being made. Many good suggestions may be rejected because those whose job it is to determine their practical merit simply do not understand what the suggestions call for.

Comprehending means understanding the immediate or fundamental meaning of something. A message is comprehensible if it can be grasped without difficulty. Whether a message — for example, a technical report — can be understood or not is dependent on many different factors, of which some relate to the sender, others relate to the message or representation, and still others relate to the receiver. Speaking and writing are language-related activities performed by the sender. These activities are influenced by the sender's earlier observations, as well as by his terminology and the language he uses. Besides being "active", the sender is in charge of "encoding" the message, i.e., its production and distribution.

Listening and reading are language-related activities performed by the receiver. As is the case with the sender, the receiver's activities are influenced by his earlier observations, as well as by his terminology and the language he uses. Besides being relatively "passive", the receiver is in charge of accepting and "decoding" the message.

The figure on the next page shows a model of comprehensibility with a graphic verbovisual message as an example. This model is also applicable to oral communication and communication via audio-visual media. The readability, legibility and reading value of the graphic message are of decisive importance to the receiver's ability to understand it. Moreover, these factors — besides being influenced by the writing process — are all prerequisites for the reading process. (Audibility, distinctness and listening value are of similar importance to the understanding of oral texts.) Therefore, we shall attempt here to show the relation of readability, legibility and reading value, as well as credibility and esthetics, to the message rather than to the sender or the receiver. By proceeding from the writing process (i.e., the terminology of the message, as well as its credibility and linguistic value), we shall try to analyse how we can achieve greater comprehensibility.

It is clear that we must help those who work with documentation, information and training to become better writers themselves, a goal that will also require the help of professional technical instructors, translators, graphics experts and designers. By developing explicit terminology, we can make things easier for writers as well as for their readers.

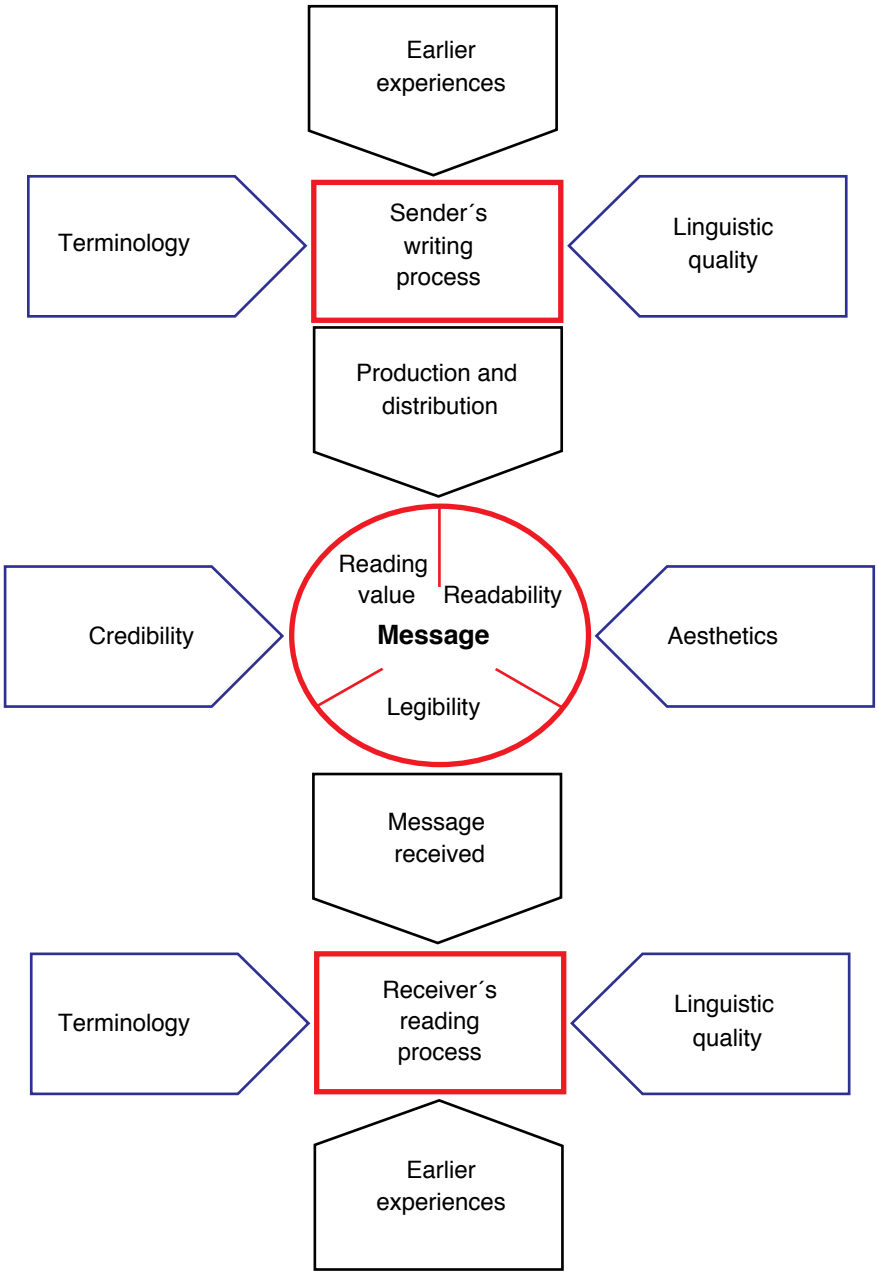

Figure 2. Our ability to understand a verbovisual message (for example, a technical report) is dependent upon its readability, its legibility, and its reading value. Comprehensibility is influenced by the message's credibility and esthetics, by the sender's writing process and the receiver's reading process.

Experiences

Texts and pictures may be either easy or difficult to interpret. The degree to which they are one or the other can depend on several different factors. If, for example, a reader lacks the background knowledge in a given field that is required in order for him to interpret a text, then there is no chance that he will understand it, no matter how diligently the writers, instructors, graphics experts and designers exert themselves. The same will be true if the reader's command of the language used is poor.

Everyone learns to read words, but we must learn to "read pictures" (Pettersson, 1989) as well. Therefore, pictorial "language" must be adapted to the viewer's capacity for interpreting it. Communication can be said to function successfully between the picture-maker and the viewer if the viewer understands, to the fullest extent, what the picture-maker wants the picture to say, and if the message conveyed is unambiguous.

Gunnarsson (1982) discusses specific reader characteristics from the perspective of the "schemata theory", which is based on the premise that we store our impressions of our surroundings in the form of schemata. The theory postulates that we have different partial impressions, such as general knowledge about different types of text, as well as different whole impressions of reality. Our deeper understanding of a text is influenced by the schemata that we bring to the fore when we read.

A few brief glances at a picture are enough for us to recognise it again among other pictures. Shopping in a department store, for example, we are passively conscious, i.e., we know, that there are a great many advertisements in the form of pictures and text — and usually background music as well — all around us, even though it all fuses into something our senses perceive as noise. It is plausible that we process most of these stimuli at a superficial level: We see and hear, but we do not look or listen. To examine this more closely, let us imagine five cognitive mental levels arranged like the steps of a staircase (Pettersson, 1989). Looking at a picture expends more mental energy and demands a higher cognitive level than merely seeing that a picture is there. Similarly, listening to music requires more concentration than hearing background music. These impressions, on being received, are conveyed from the sensory memory to the short-term or "working" memory. Some of the information proceeds on through the filtering system and becomes consciously perceptible to the receiver. However, after a short while, most of this information disappears.

When we study, we take an active part in the contents of the material. We read texts, we listen to music, we read pictures. This consciously perceived information is processed, sorted and stored in certain parts of our long-term memory. In the case of a picture, we may need to focus on different portions of it a number of times (so-called "eye fixations") to be able to describe it later on.

Conscious analysis of verbal messages requires even greater expenditure of mental energy and demands a still higher cognitive level. Most demanding of all are the creative processes that make it possible to create texts, music and pictures. Authors, composers and artists all bear witness to the mental strain that can be a part of the creative process. The cognitive model with its five levels, as shown above, presupposes a dynamic mental process in which we change cognitive levels both consciously and unconsciously.

Our sensory organs react to changes in our surroundings. Normally, we can perceive changes (in spatial properties, for example) that are greater than about two per cent. On the other hand, we adapt ourselves to slow, gradual changes, so that we barely notice them at all. Our normal condition, therefore, is a state of mental repose that affords us the capacity for sudden, rapid activity. Correspondingly, we cannot keep ourselves at the highest cognitive levels for more than a limited time; the effort would require too much energy and would probably induce some kind of mental "cramp". Like a pike lurking among reeds, or a cat spying outside a mouse's hole, we know what our surroundings look like. If something happens to change some familiar element in our milieu, we can react swiftly and decisively, impelled by a rush of mental and physical energy. Sometimes things turn out fine: The pike gets his minnow, the cat gets her field-mouse, and we find the information we are looking for. But things can turn into a muddle, too: The predators fail to capture their prey, and we end up wasting time and energy trying to make sense out of uninteresting information.

Because they influence us in an emotional way, pictures have an enormous impact. Children, for example, can be easily frightened by violent action on TV, but they are not upset by reading about violent action in a book. This is in part because what we see seems more tangible to us than what we read, but it is also because reading a text requires a higher cognitive level than viewing a picture does. Several researchers, among them Tröger (1963) and Noble (1975), have demonstrated that very small children are incapable of taking an active part in the content, or understanding the context, of material shown on a TV screen. Most parents with toddlers have made the same observation.

There are no fixed or distinct borders between the five levels of our cognitive model. Depending on cultural, social and intellectual factors, there may be great differences between various persons' ways of conforming to the model. Then too, mood, health, surroundings and a number of other circumstances can cause one and the same individual to react very differently at different times. However, what the model reveals is that there is in fact a great difference between the concepts of seeing — looking — reading and hearing — listening.

Actively taking part in a linguistic message that consists of text, sound or pictures, either together or separately, always implies the exertion of effort, i.e., work. Reading or listening taxes our faculties; sooner or later we become tired.

Furthermore, material that is poorly constructed and/or presented strikes us as dull, and not only causes our interest in the subject to wane, but leaves us exhausted.

This applies irrespective of whether a message is meant to impart information, instruction or entertainment, It also applies irrespective of the medium of conveyance, except insofar as different media have entirely different capacities for conveying a message from a sender to a receiver.

Strömquist (1991) points out that we all have proficiency in, and insight into, the labours of writing. We all know how writing is done. We know that "the writing process" consists of more than simply committing words to paper; indeed, it presupposes long-term memory and familiarity with the things that have to do with writing. In other words, writing is an extensive, time-consuming, dynamic, gradual, cognitive and strenuous business.

The writing process

The section "Writing advice" contains concrete instructions, i.e., rules of thumb, on how to write so that your text will be understandable. The physical act of writing down one's thoughts with the help of a pen or a keyboard does not usually require a great deal of time. It generally takes longer to think what the text should consist of than to formulate it. Thus, the writing process encompasses much more than merely writing, and it is relatively independent of the language used. We work more or less the same way when we write English as when we write Swedish or any other language.

Before we begin writing, we need to identify the subject and define the purpose of the message. This always requires analysis of the target group or receiver. Receiver analysis might contain evaluation of the receiver's basic understanding of the subject, his trade knowledge, experiences, skills, comprehensive capacity, attitudes, prejudices, motivation, linguistic competence, social background and vocation, as well as his age and the groups he belongs to or identifies with. Because all of these factors influence how the receiver takes in and understands a message, they are decisive to how we shall formulate the text.

To begin with, we shall need to gather and sort our material, as well as plan and outline our presentation. We need to choose the type-face, graphical form and medium. It may be possible to use fixed writing patterns and established models. When we have formulated the text, we shall need to process it and adapt it, so that it will suit our target group. We may have to rewrite the text as many as ten times before it is right. Although it may be true that even the most complicated texts can be presented in a comprehensible form, all writers need practice, practice and still more practice. Liljestrand and Arwidsson (1979, pg. 15) assert the following (in translation):

> Complicated texts are often defended on the grounds that their subject matter is complicated. In reality, however, the more difficult the subject is, the more one must attempt to express it in a comprehensible way. It is surely more reasonable to expect that someone who is writing for several people expend effort on the writing of his text, than that the various receivers be obliged, each on his own, to expend effort interpreting it!

Also Strömquist (1991, pg. 35) maintains that everyone must practice writing to become good at it. Writing is a skill that we can learn. She says the following (in translation):

> It is only by writing oneself that one can fully understand the complicated writing process; it is only by writing oneself that one discovers where the problem lies.

Texts may need to be augmented by the addition of pictures, for example, photographs or schematic diagrams. I often begin the work of writing by making a comprehensive picture, which sometimes develops into a short suite of pictures before I begin work on the text. Bergquist (1991) gives textbook authors five terse, vigorous instructions in the form of "commandments "(in translation):

- The first commandment: Don't write! Even if the author's first impulse is to start writing at once, it is essential to begin with an outline.
- The second commandment: Use pictures! Get a picture to illustrate each section; wait with your text.
- The third commandment: Write captions for each picture! Each picture should have a relevant text, which may even have a heading.
- The fourth commandment: Talk to your editor! Together, the writer and the editor can expand a factual outline into a detailed outline for each layout. The outline contains room for both text and pictures.
- The fifth commandment: Write in a structured manner! The text should complement the pictures. Therefore, write in the space between the pictures. The editor provides the author with exact data about the number of strokes each line of text may fill.

The actual process of designing and creating integrated verbovisual information is called "infography". When text, picture and graphic form are integrated into a fully delimited, structured surface (a functioning whole), the result is a graphical information entity, usually known as information graphics, that can be interwoven with texts and pictures in an information layout.

Quality of language

There are several different subheadings under the general heading "quality of language", among them, phonology, morphology, syntax, style, pragmatics and infology.

- Phonology is the study of phonemes, i.e., the smallest units of semantic differentiation found in spoken language, and combinations of these units. The smallest written unit that fills a semantically differentiating function is called a grapheme.
- Morphology, the study of form or structure, deals with how words are formed and inflected.
- Syntax is the study of the rules for combining words into grammatical phrases, clauses, sentences and paragraphs.
- Style is the way of expressing thought in writing or speaking by selecting and arranging words for clarity, effectiveness and ease of reading.
- Pragmatics is, in linguistics, the study of the causal and other relations between words and how we connect words to express ourselves correctly.
- Infology is the study of how verbovisual information is presented and read.

The way in which good quality of language is defined is, to some extent, dependent upon the purpose of the text. Technical writers, for example, are more consciously concentrated on getting results than other writers. Because technical language must be capable of effectively conveying as much information as possible to a certain group of readers, it is characterised in its ideal form by brevity, clarity and precision (see the section on "Terminology").

According to Melin (1992), comprehensibility in a text is largely dependent upon perspective, abstraction, context, complexity and redundancy. As it is, these qualities are themselves difficult to describe; small wonder, then, that the comprehensibility of text defies assessment.

In an experiment, Kirkman (1992) allowed a group of people to rate six different versions of four technical and scientific texts. In terms of content, the texts were equal to each other, but they varied in their style of language. All told, some three thousand people took part in the experiment. In the case of all four texts, the test group rated the versions that were written in an active, direct and personal style as being the most easy to read and understand. Contrarily, the versions written in a passive, indirect and neutral style, with complicated sentence structure, were judged by the test group as being the most difficult to read and understand.

To describe the properties of text, the linguist works with advanced text analysis. However, it is relatively easy to describe a text's readability by using a readability index, a character index, and a nominal quotient.

The premise on which the readability and character indexes are based is that long words and sentences make a text difficult to read. The readability index is the sum of two calculations: the percentual proportion of long words (consisting of — depending on the language in question — the number of letters or syllables in a given word), and the average number of words per sentence. The *readability index*, while usually corresponding rather well both to people's subjective experience of a text's readability and to their results in comprehension tests, has received strong criticism because varied sentence length actually contributes to ease of reading.

The *character index* can be looked on as a visualisation of the readability index. Each sentence is analysed and noted on a chart depicting a system of coordinates, in which the y axis represents the number of long words and the x axis the number of words per sentence. Thus, by graphically providing more than a single mean, the character index offers more thorough information about a text than the readability index does.

The *nominal quotient* gives the total number of nouns, prepositions and participles divided by the total number of pronouns, verbs and adverbs. A good information text has a quotient of slightly more than 1.0. Text with a lower nominal quotient seems "chatty", whereas text with a higher nominal quotient is cumbersome.

Research into readability has been directed towards finding the characteristics that make texts easy or difficult to understand. Gunnarsson (1982) points out that the psychological equivalent to "readability" is merely superifical understanding. Therefore, she prefers to use comprehensibility as the term for characteristics that are related to deeper, specific text understanding. Gunnarsson's theory of comprehensibility is based partly on the correlation between the level of understanding and the level of the text, and partly on the premise that what is read influences the reading process.

It is also possible to calculate the readability of pictures (Pettersson, 1989) by using the picture-readability index, which takes into account a picture's functional properties and expresses how easy or difficult the picture is to read. A picture that we are unable to understand cannot communicate any factual information. The easier it is to read a picture, the better it can convey information.

In the USA, there is an increasing incidence of lawsuits being brought against manufacturers. These suits claim damages as a result of accidents occurring or products breaking because of poor quality in the language of instruction manuals (Helyar, 1992). The courts are demanding that technical manuals, brochures, information sheets, labels, etc., be written in comprehensible language, and that descriptions and instructions be readable and legible. Everywhere, plaintiffs' counsels are searching frenetically for sections of text and parts of pictures that might be interpreted in conflicting ways. If a manufacturer's technical documentation is difficult to understand, he can lose a lawsuit.

The message

The message is the link between the sender and the receiver. The sender designs the message and sends it off. The receiver receives it, and tries to understand it.

Teleman (1991) points out that the systems of rules that govern spoken and written language are similar in many ways. Originally, writing was a way of depicting speech, but the two coded systems later went their separate ways. The most tangible feature of the rules for written language is their standardisation. In most western countries, the written language is comprehensible throughout the country and does not reflect differences in dialect.

An essential difference between the spoken and the written message is the time available for transmitting them. The production of speech must take place in the here and now; the speaker and his listener communicate in real time. On the other hand, the writer and his reader can take all the time they need.

In the written message, legibility, readability and reading value are vitally important to the message's comprehensibility.

Legibility

The graphical message's legibility is determined by the technical design of the text and the picture, i.e., their clarity. Legibility can be measured rather objectively, and its quality is assessable whether we understand its content or not. As far as the text is concerned, we should avoid unusual type-face, as well as type-face that is too small or too large.

We read each word in a text as a "picture", not letter by letter. In a book it might be sufficient to set the type between nine and twelve points, although on a display screen, the text should be at least three to five times as large. The text on a poster meant to be read from some distance may need to be ten times greater in size. Legibility in the written word is comparable to audibility in the spoken word.

Readability

The readability of the message involves the reader's ability to understand its text and pictures (compare the earlier section on the readability and character indexes and the nominal quotient). Readability is determined by the content and its presentation, and depends upon the degree to which it is adapted to the receiver's capacity to understand it. The writer and the picture-maker need to take into account the reader's knowledge, interests and needs in order to compile, sort and structure the material. This is also true with regard to the formulation of texts and pictures. Readability in the written word is comparable to distinctness in the spoken word.

Reading value

The message's reading value is the receiver's subjective evaluation of the content of the text and pictures. What is interesting to one person can be deemed dull by another. We must therefore adapt text as well as pictures to be palatable to any given target group. Reading value in the written word is comparable to listening value in the spoken word.

Pictures

When producing informative material, the sender always has a reason for adapting his message so that the receiver understands it. Pettersson (1989) reports on a number of experiments in which altogether 4,350 people described how they interpreted the contents of different pictures. The experiments clearly showed that:

- How a picture is understod is a relative thing. Different people understand and describe the same picture in different ways.
- Even simple pictures need plain captions in order for the contents and presentation to be conveyable in verbal form.
- Pictures of abstract subjects are understood in considerably more varied ways than pictures with concrete subjects.
- Abstract subjects are described in concrete terms.
- The same intended theme or subject can be expressed through many different pictures.
- Texts and pictures are completely different "languages "that complement each other.
- The possibilities for combining texts and pictures are virtually unlimited.
- There is not likely to be just one but several equally good options available for achieving satisfactory communication.
- Pictures that will be used for information purposes should always be given captions that confirm the interpretation that is most relevant in the context.
- The interplay between text, picture and graphic form needs to be studied thoroughly before optimal combinations can be found.
- We are able to differentiate between "immediate" and "analytical" understanding of pictures.
- We create a "pre-understanding" of how a picture should be interpreted based on the context in which the picture is shown.

Media

As a rule, the content of films and television programs is presented in a preordained fashion, which tends to encourage relative passivity in viewers. The same is true of prepared oral presentations. The reader of a book digests textual and pictorial information at his own pace. If the information presented in the book has a structured surface, i.e., one in which the information is integrated into a single context, the reader can focus his attention relatively freely. The experience is akin to the way we take in information in real-life situations.

Interactive video programs make it possible to combine sound and moving pictures; thus, they can arouse considerable activity and commitment in the user. Because an interactive video program can stimulate the user to perform at a high cognitive level, it has the potential to function well, both as a conveyor of information and as a teaching aid.

Credibility and aesthetics

For a message to be effective, it needs not only to be credible but to merit credibility as well. First, its content must be correct and the quality of its text and pictures beyond reproach. Convincing arguments, proper references, and relevant examples are other requirements, as is presentation of the message in concrete — as opposed to abstract — terms. Credibility can also be influenced with the help of typography and layout.

The National Swedish Psychological Defence Planning Committee has carried out comprehensive studies of various media's credibility (see Törnqvist, 1974, and Arvidsson, 1981). Receivers of information evaluate credibility according to how they perceive the straightforwardness, the factual content and the comprehensibility of the message.

Thus far in these tests, ether media have always won the greatest credibility. At the end of the 60s, television was considered superior in credibility, although by the beginning of the 70s, radio was considered most credible. During the 80s, radio and television were felt to be equal in credibility; fully 80% of those questioned were in accord with this. However, it does not seem as though people in Sweden trust the information found in newspapers. In the autumn of 1981, slightly more than 10% judged the morning papers to be "most credible", while only 1-2% made that assessment of the evening papers' information.

It is primarily the younger generation who have the most faith in TV. The older we are, the more credible we find the morning papers. Furthermore, trust in the morning papers is greater the higher our level of education is.

Material with a (sufficiently) pleasing esthetic form has greater potential for conveying a particular message than does unesthetic material (Pettersson, 1993). The sender's choice of graphical form will generate either positive or neg-

ative expectations in the receiver, while the choice of typography and layout can often give the reader a pre-understanding of the message's content. In other words, it is important that a visual message exhibit good legibility, or, if it is a spoken message, distinctness. The message may be esthetically pleasing, but its content is more important than its form.

Terminology

There are as many different varieties of shop-talk, i.e., trade jargon, as there are vocational fields. In technical reports, for example, one finds far more detail and uncommon wording than in the language at large.

Terminology, the study of terms, encompasses terms, concepts, idioms, definitions, references, conceptual systems and semantics. A term is a word or expression for a particular concept found in a given field of work, in which it has a specific and carefully determined meaning. A concept is an idea of something formed by mentally combining all its characteristics or particulars. An idiom is a fixed expression whose meaning is not discernible from the definitions of the individual words of which the expression is made up. A definition is a description of a concept rendered in words. A referent is an object, abstract or concrete, for which a name or designation stands. A conceptual system, or a conceptual hierarchy, is a systematic description of the relations between the various concepts in a particular area of thought. Semantics is the study of the meaning of verbal expressions and the implications of combinations of words.

The subjects lexicology and lexicography also belong to this area. Lexicology is the science that deals with the structure of vocabulary. Lexicography is both the study of how dictionaries are compiled and the actual process of compiling and writing them.

The reading process

Both the reading and the listening process require decoding of symbols, pre-understanding of words, phrases and pictures, and, finally, comprehension of the content of the information. Furthermore, as we mentioned before, the legibility, readability and reading value of the written message influence the reading process. In the case of the spoken message, the message's audibility, distinctness and listening value influence the hearing process. As far as the receiver of the message is concerned, the following are some of the factors that greatly influence his or her intake of information:

- Earlier experiences and observations

- Perception
- Learning
- Memory
- The reading objective
- The reading procedure
- Pre-understanding

Memory

Reading texts and pictures, and actively listening, are dependent on our short-term memory, as is all mental activity. Only a certain limited amount of information can be contained in the short-term memory at any time. New information crowds out information that is older than about a second, and the older information easily disappears if we are not prepared to store it in our long-term memory. If we repeat the information a few times, we increase our chances of remembering it. Long, complex words and sentences are difficult to understand. If the functions of the individual words in a text are not immediately apparent to us, our short-term memory becomes overloaded with long chains of words that cannot be directly put into a meaningful context.

The reason for taking in the information

Gunnarsson (1982) discusses five different categories of reading objectives. What differentiates them is the kind of stored knowledge that must be invoked in order for understanding to take place. Of course these categories are not sharply delimited, but overlap.

- In memorisation of the textual surface, the objective is to create a visual memory of the text's surface.
- In registration of the text's content as such, the objective is to understand the written message's structural and conventional importance.
- In comprehension of the sender's description of reality, the objective is to understand what the sender means by the text.
- In integration of the text into one's perception of one's own surroundings, the objective is to integrate the text into one's own earlier experiences and observations.
- In direct, action-related comprehension, the objective is to know how one should behave in different situations, based on what the text says.

The first objective involves reading in order to recognise each word and memorise the text surface, while the second requires us to read and understand

the words in the text. With objectives three to five, reading is directed towards individual sentences, parts and the whole of the text, and other proficiencies and ideas are brought to bear on the material. Objective three, for example, obliges the reader to interpret the text in terms of the sender's situation. Objectives four and five require that he interpret the text in terms of his own surroundings and world view.

Möijer (1987) states that we read in different ways depending on what purpose our reading serves. We read intensively, every word and line, when our purpose demands it. We skim if we only wish to quickly get some idea of the material. We read to orient ourselves if we want to know where in a text some particular information is found. We read to inform ourselves when we need certain limited information. In each of these cases, we leave out anything that does not directly satisfy the purpose of our reading.

Different reading objectives (Gunnarsson) or purposes (Möijer) attached to reading give rise, therefore, to different reading purposes. These purposes differ in terms of the level of text on which the reader focuses, and in terms of how the material is processed.

The reading procedure

According to Gunnarsson (1982), the reading procedure is of great importance to the reader's capacity for understanding a text. In "normal reading", we direct our attention towards how we shall interpret the meaning of a sentence. Studying the syntax becomes subordinate to orienting our thoughts amid the semantic and pragmatic relations that form the text's warp and woof. When we read long continuous texts, we process separate sentences with an eye to their integration into the material's entirety. This takes place gradually, with the text that we have already read providing the framework. Text comprehension is a constructive process, in which the reader builds up his perception of the whole by integrating the text with his own experiences.

Pre-understanding

An important step in the reading process is pre-understanding (Pettersson, 1989). As I mentioned before, the graphical form of a text creates expectations in the reader regarding its content. We expect certain types of documents to look a particular way; contrarily, when we see a document of a certain type we expect a particular type of text and pictures to accompany it. Thus, it is in the light of these expectations that we activate the cognitive processes needed to interpret the message. The reader develops his own methods for predicting what a text will be about. Introductions, abstracts, tables of contents, summaries, illustrations and tables all have important functions to fill.

Television producers are usually good at showing what their programs are about. In countries with a great many TV channels, it has been noted that viewers switch rapidly between different channels until they find a program that awakes their interest. Sometimes a viewer will make up his mind within the space of a couple of seconds (Matsushita, 1988).

Language that is rich in similes and metaphors makes it easier for the reader to paint his own inner pictures. A well constructed text with clear, distinct arrangement and lucid paragraph disposition, organised under well formulated headings and captions, affords the best reading experience.

Costs

When a great many people are required to read and understand information during working hours, the cost incurred is great. It can be expensive to produce information, but it costs even more to store, find and use it. The greater the number of individuals who must partake of certain information, the greater the cost will be. The cost of reading is determined by the type of documents that will be read, as well as by the groups that will read them. Thus, presenting information in a suitable way offers great opportunities for saving money. In the handbook called "Plain Talk from the Cabinet Office",that is provided for use by members of that body, Ehrenberg-Sundin (1982) states that judicious planning of texts can save millions. She writes as follows (in translation):

> It is expensive to read texts! The cost of reading is often many times greater than the cost of writing and printing the material. Besides, if readers do not understand the text, or if they interpret it incorrectly, it becomes VERY expensive! This problem can be solved by planning text better. It should have a purpose and the selection of its content must agree with that purpose. Thus, we can avoid the greatest reading expense. If we help the reader further by writing comprehensible language and giving the text a sensible presentation as well as an arrangement that is logical to him, we shall have saved still more time and money.

The cost of reading and understanding text is in most cases many times greater than the cost of producing it. Ehrenberg-Sundin offers an estimate:

> For a report that has cost SEK 80,000 to print and just as much to write (four months' salary for a committee secretary), the cost of reading it will be SEK 1,600,000 if 1,000 persons spend eight working hours each (at SEK

200 per hour) to read and understand it.
The greater the number of people who are meant to read a text, the greater the incentive is to expend extra effort on making it easy to read!

In private companies, the cost per hour is usually reckoned at SEK 400 or more, instead of SEK 200. (Since 1982 these costs have increased considerably due to inflation; however, the ratios remain the same.) Thus, in industry, savings in this area can be still greater than they might be in the public sector.

Melin and others (1986) refer to a cost estimate that was carried out at the Swedish Telecommunications Administration (Televerket). The total cost of a 20-page technical report was estimated in SEK per page as follows: writing 5.60, printing 1.40, storage 25.00, and reading 225.00. In other words, the cost of reading the report was many times greater than all the other costs put together. The author's work on the text represented only two percent of the total cost.

Writing advice

Against the background of the previous discussions (regarding comprehensibility, communication, experiences, the writing process, quality of language, message clarity, credibility and esthetics, terminology, the reading process, and costs), it is possible to give some concrete advice, or rules of thumb, on good writing strategy as the key to good comprehensibility. These rules of thumb, besides being written so that any writer can easily follow them, are divided into the following sections: Analysis, preparation, writing, using pictures, and doing the final touchingup. In some places, references to relevant literature are given, if you want to penetrate the material more deeply.

Analysis

- Investigate who will read your text.
- What characteristics do the readers have?
- What is the purpose of your message? Do you want to inform, give instructions or influence your readers?
- Are the readers positively or negatively disposed to your message? What are their expectations?
- How will you convey your message to the readers? What medium or media will you use?
- What financial conditions or limitations apply to your work?
- What external factors can influence how the readers will interpret your message?

Preparation

- When you create a message, always proceed from what you yourself know about the readers. What is the readers' level of knowledge?
- Draw up a preliminary plan for your writing. Allot sufficient time for it.
- Gather material, for example, by reading, interviewing people, making observations and performing experiments.
- Collect the pictorial material (see “Using Pictures” below).
- Sort out the material that will be included with your text. Proceed from what you know about the readers' potential for understanding it. Focus on the most important aspects.
- Structure the material. Make an outline of your subject; it can later be refined and given more detail. A technical report should have a title, a table of contents, an abstract or summary, an introduction, description and analysis, a conclusion (including your own viewpoints) and a list of sources or references. Avoid footnotes and appendices, as they are seldom read.
- There are different types of outlines, for example, narrative and logical outlines. Do not switch between different types in the same document.
- Write an interesting title and, if you like, a subtitle.
- Choose a graphical form that suits the material. It will make things easier for the readers if information of the same kind is presented in a similar way. A well-thought-out graphical form contributes to the readers' understanding.

Writing text

General

- Let your writing be simple, clear and concise. Express yourself in specific rather than unspecific terms.
- Use a style that is natural for you. Avoid both colloquial language and excessively formal constructions.
- Analyse, argue, describe, compare, refer, make associations, spin a tale, all according to what you think is needed.
- Try not to insinuate subjective values into your text. If it is your own opinion you are expressing, make this plain.
- Avoid writing in a style that is too laconic or sterile, but don't allow yourself to become “chatty”. Sentences that are too dense, i.e. sentences in which too many ideas are concentrated, will make your text tedious reading.

- Use aids, such as dictionaries and encyclopedias. For a guide to English writing, see The Economist (1991) "Style Guide", "Good Style" by Kirkman (1992), and "The Elements of Style" by Strunk and White (1979).

Words

- Avoid long, polysyllabic, complicated words.
- Avoid buzz-words, slang and expert jargon.
- Use defined, established terminology. If you are obliged to use abbreviations, define them in full the first time they appear in the text.

Sentences

- Try to have your sentences say one thing at a time, don't cram them with ideas. In general, try to vary the length of your sentences to increase reading ease, but avoid sentences that are too short or too long.
- Avoid complicated word order and subordinated clauses. Be particularly careful in your placement of modifiers. Avoid the passive voice ("The B process is affected by A"); write active sentences ("A affects the B process"). Use verbs instead of nouns and gerunds.

Paragraphs

- Let every paragraph encompass a single unit of content. Avoid long, convoluted paragraphs that meander in all directions.
- Link sentences and paragraphs with conjunctions and/or adverbs (and, nevertheless, moreover, because, but, however, therefore, although, because, since, or, even, thus), making sure at the same time that the things linked together bear a logical relation to each other. In the sentence "the project was terminated due to calculated project costs and more profitable use of resources", the phrase "terminated due to" implies that whatever is to follow will have had a negative effect on the project's progress. However, "calculated project costs" and "more profitable use of resources", besides being neutral rather than negative in effect, have no logical relation to each other, nor do they tell why the project was terminated. The sentence should read: "The project was terminated due in part to project costs being calculated as excessive, and in part to the necessity of putting resources to more profitable use."

The entire piece

- There should be a "red thread" running through the text. Try to find a unifying principle. Clearly show what it is that you want to express.

- If the subject is on a high plane of abstraction, use concrete examples that illustrate the principles.
- Use similes and metaphors. They make it possible for readers to paint an inner picture.
- If the text shows a high degree of specification and examines a great many separate details, you should summarise every now and then, and draw conclusions.
- Sometimes you may find it necessary to write your foreword, introduction and summary after the body of the piece is written.
- List your references clearly.

Using pictures

- Use pictures to make it easy for the reader to understand your message.
- Any pictures you use should be clear and easily read. Pictures should always have captions.
- Pictures and text must interact to produce a seamless unity.
- Place texts and pictures that belong together as close to each other as possible.
- Do not change the content of a picture by using different forms of computer manipulation. This practice is often unlawful, and always unethical.
- Never try to pass off inauthentic pictures as being true depictions of reality.
- The source of any borrowed pictures should be identified.
- For a guide to visual language see "Visuals for information. Research and practice" (Pettersson, 1989).

Doing the touching-up

- Let your text "rest" for a week or so, then read it from the reader's point of view. Make the necessary amendments.
- Check that the finished text corresponds to the text as you had planned it.
- Edit your text! Polish it. Trim away any unneccessary bulk. Iron out inconsistencies. Simplify the language. Clean up the punctuation. Every sentence should be easy to read!
- Check style and grammar. Discrepancies in grammar and style hinder the reader's progress and make the writer less credible in his eyes.
- Check spelling and word division at the end of lines. In some cases, functions in your word processing program can help you with this.
- Check references and other formal aspects of your paper.

- Refine the typography and layout so that the headings, tables and pictures are presented in a lucid, esthetically pleasing graphical form. Make optimal use of the possibilities that typography offers.

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Paper 8

Credibility

Abstract. *Credibility is dependent on the perceptions and interpretations of the receivers, and not necessarily on any actual characteristics of the senders or sources. All people does not seem to realize that pictures seen in media are selected and edited, and only represent a "fragment" of reality. It is possible that people often believe that image content is "true." The credibility of a picture is influenced by the credibility of the source, the message, the medium, and the specific context.*

Arvidson (1977, 1980) discussed early research on credibility with respect to mass media and defined four credibility concepts; confidence, credibility, believability and accuracy. According to Arvidson confidence and believability are properties of the public; while credibility and accuracy are properties of the mass media. Confidence, credibility, believability and accuracy are all important aspects of *persuation*. And Bettinghaus and Cody (1987) noted that (page 84): "There are a number of early studies that clearly establish credibility as an important factor in persuation." Thus, sources possessing more credibility for a given audience are more effective in persuation.

What makes a picture credible? What does it mean that a picture has high credibility? What does a high credibility picture look like? What is the actual meaning with the concepts *credible* and *credibility*? Let us see how these words are defined in a few contemporary dictionaries (see Table 1).

One of the three words *believe, believable* and *belief* are used in most of the definitions. It is obvious that in communication the *receiver* of a *message* believe in a *sender* with high credibility. However the sender, the message and the receiver may not be the only properties of credibility. In my view (1) the sender or the source, (2) the message, (3) the medium, and also (4) the specific context may be important components or parts in the perception of credibility. These four components all influence each other and – in my view – they also influence our overall notion or understanding of credibility (see Figure 1).

Table 1. Definitions of the concepts credible and credibility.

Concept	*Definitions*	*Reference*
credible	deserving to be believed, trusted, or taken seriously	*The Longman Dictionary of Contemporary English.* Longman, 1990; p. 241
	1. Believable; worthy of belief or support 2. Ready, willing, or inclined to believe	*The new shorter Oxford English Dictionary.* (Brown, 1993), p. 545
	1 (of a person or statement) believable or worthy of belief 2 (of a threat etc) convincing	*The Oxford Dictionary and Thesaurus.* Tulloch, 1995; p. 337
	capable of being believed: deserving to be believed	*Webster's New Encyclopedic Dictionary.* Webster's, 1993; p. 236
	1. capable of being believed, believable 2. worthy of belief or confidence; trustworthy	*The Random House Dictionary of the English Language.* Berg Flexner, 1987; p. 473
credibility	the quality of deserving belief and trust; being credible	*The Longman Dictionary of Contemporary English.* Longman, 1990; p 241
	the quality of being credible; good reputation	*The new shorter Oxford English Dictionary.* Brown, 1993; p. 545
	1 the condition of being credible or believable 2 reputataion, status	*The Oxford Dictionary and Thesaurus.* Tulloch, 1995; p. 337

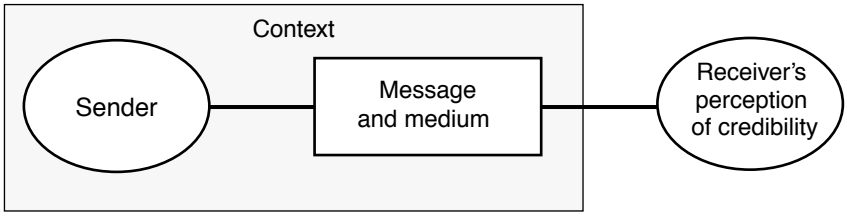

Figure 1. Perspectives on credibility. The sender transfers a message to the receiver with the help of a medium. A medium with a specific message is a "representation" (Pettersson, 1989, 1993, 1996). The sender, the message, the medium, and the specific context are important factors in the perception of credibility.

Credibility of the sender

Fleming and Levie (1978) noted that (page 199): "The credibility of a source is an attribution that is conferred upon the source by the receiver." Tedeschi and Rosenfeld (1980) stated that (page 234): "Credibility refers to the truthfulness of the source over the occasions when his or her communications can be checked for accuracy." And Bettinghaus and Cody (1987) defined credibility in the following way (page 85): "Credibility is a set of perceptions about sources held by receivers." Thus, when we want to find out if a source is credible, we chould ask potentional receivers about their opinions on the matter. The source or the sender may be an "institution" such as a broadcasting company or a newspaper. The sender may also be an individual person.

According to Bettinghaus and Cody (1987) almost every study on source credibility seems to agree on the existence of both an expertise or a competence factor, and also a trustworthiness or a safety factor. There are obviously various *levels of credibility*. At least we can distinguish between high and low levels. A source with a high degree of *trustworthiness* may be described with words like: agreeable, calm, congenial, ethical, fair, forgiving, friendly, gentle, honest, hospitable, just, kind, nice, patient, pleasant, sociable, unselfish, and warm. The opposite words would describe a source with a low degree of trustworthiness. A source with a high degree of *expertise* may be described with words like: able, accurate, authoritative, experienced, informed, intelligent, knowledgeable, skillful, and trained. In this case the opposite words would describe a source with a low degree of expertise.

High-credibility sources exert a more persuasive influence on the receivers than low-credibility sources. Thus, for the sender it may be very important that receivers are informed about the level of expertise of a high quality source. And this is often seen in advertisements where selected *experts* give their "expert opinions" on the quality of a specific product or a certain service.

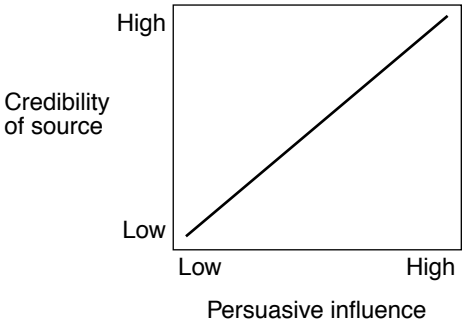

Figure 2. Level of credibility. High-credibility sources exert a more persuasive influence on the receivers than low-credibility sources.

Hovland, Janis and Kelley (1953) stated that people who show high acceptance of a message from a high credibility source may show less acceptance later on, after a few weeks. They called this the *"sleeper effect."* Through the 1950s and 1960s the sleeper effect had a firm place in the persuation literature. However, later Cook and Flay (1978) demonstrated that the sleeper effect could not be reliably demonstrated without very specific conditions.

According to Fleming and Levie (1978, page 225) the adverse effects of a low credibility source can be lessened if the source is identified after, rather than before the message is presented to the audience. Once people have made up their minds and formed their opinions they are not always inclined to change these opinions easily. Hovland, Janis and Kelley (1953) also argued that people who receive a message from a source with low credibility may show an increase in acceptance of the message after some time has passed. The negative influence from the source diminish.

Kouzes and Posner (1993) studied the *credibility of leaders*, and how leaders in business may gain and may lose their credibility. They found that most people appreciate leaders with high credibility. Above all such leaders are honest, foresighted, inspiring, and competent. They are also just, fair, supporting, liberal and broadminded. According to Kouzes and Posner a credible source is reliable, objective and dynamic.

Ehrenborg (1984) declared that the *credibility of a speaker* is very much influenced by his or her actual performance in front of the live audience. Any message must always be in close agreement with the body language. A speaker that is lying will usually be exposed by his or her body language. An audience will believe what they see much more than what they hear. Thus it is also very important for the speaker to use slides, overhead transparencies and other visual support of high quality. When a speaker uses visual aids of poor quality this will influence the receiver's perception of the credibility of the speaker. The use of inferior overhead transparencies and slides may actually be devastating for the credibility of the speaker as well as the credibility of the message.

In connection with accidents, crimes and verdicts several researchers have discussed the *credibility of eyewitnesses*. Eyewitness identification has been cited as the single most persuasive source of all kinds of evidence that can be used in a court of law (see Woocher, 1977; and Loftus 1996), but also as the most frequent cause of wrongful convictions (Rattner, 1988). The reliability of testimony depends on many factors, including circumstances at the time of an event, the witness's emotional state and memory function, etc.

According to Lindsay (1994) eyewitnesses are generally considered by jurors to be highly credible sources of evidence. However, many factors can intervene and create inaccurate testimonies. Memory can be radically altered by the way an eyewitness is questioned, new memories can be implanted and old ones altered in subtle ways (Loftus, 1996). Some witnesses find it easy to

remember events accurately and in great detail. The memory of other witnesses may be faulty. They sometimes fill in memory blanks unconsciously so a memory still seems correct to them. Such a witness might then be convinced that she/he is supplying highly accurate information, even when it is highly inaccurate. According to Christianson (1990), witnesses often change their recollections to conform with descriptions supplied by other witnesses or information in the media. This is a subconscious process that is independent of whether an event was emotionally charged or banal.

After a series of experiments with mock jury studies Lindsay (1994) found that witness confidence consistently influenced juror verdicts and perceptions of witness accuracy, whereas a variety of other factors had little or no effect on the verdicts. Jurors actually made a determination of guilt or innocence by distorting the evidence to conform their decisions. Lindsay concluded that the most important contributions that psychologists can make in the eyewitness area will result from developing techniques that increase the accuracy of eyewitness reports, or the accuracy of eyewitness identifications.

Leippe (1994) discussed the appraisal of eyewitness testimonies. In three experiments credibility judgements of witnesses' memory reports included ratings of believability, confidence, consistency, estimate of cued recall, and confidence in identification accuracy. Leippe views eyewitness testimony as "persuasive communication" whereby the witness attempts to persuade the jury that his or her testimony is accurate. A variety of factors influence the believability of eyewitness testimony. Leippe concluded that a thorough understanding of eyewitness persuasion is an important theoretical and practical goal. This is an area where a lot of work remains to be done.

Credibility of the medium

Communication takes place when a sender successfully conveys a message to a receiver. The sender transfers the message to the receiver with the help of different media. A medium with a specific message is a representation (Pettersson 1989, 1993, 1996). All representations are the result of biological, cultural, economical, emotional, historical, political, religious, social, and subject matter factors. Actually, all we have got to communicate with are various kinds of representations. Obviously, the sender wants the representation to have high credibility.

According to Becker, Martino, and Towers (1976) the credibility of a medium depends on a number of variables, including receiver characteristics such as age, gender and level of education. The National Swedish Psychological Defence Planning Committee has carried out comprehensive studies of the credibility of various media (see Törnqvist, 1974; and Arvidsson, 1977, 1980, 1981a,

1981b). At the end of the 60s, television was considered superior in credibility, although by the beginning of the 70s, radio was considered most credible. During the 80s, radio and television were felt to be equal in credibility; fully 80% of those questioned were in accord with this. It does not seem as though all people in Sweden trust the information found in newspapers. In the autumn of 1981, slightly more than 10% judged the morning papers to be "most credible", while only 1-2% made that assessment of the information in the evening papers. It is primarily the younger generation who have the most faith in television. The older we are, the more credible we find the morning papers. Furthermore, trust in the morning papers increases with our level of education.

According to Keller and Burkman (1993) learners will be more motivated to learn if they believe in the truth and appropriateness of the materials presented to them. The credibility of an instructor or a set of course materials is influenced by several factors concerning the qualifications of the instructor, the reputation of the publisher, the quality and structure of the arguments in a message, and the correspondence of values and beliefs between the learners and the source of materials. Thus Keller and Burkman formulated the following "principle of motivation" (page 22): "Learner confidence and efforts to succed are increased in proportion to the perceived credibility of the source." Keller and Burkman also noted that commercial producers have found that users' first impressions of a media product are very important to getting them to adopt (buy) it. Consequently, they spend a lot of time and money in giving their products a favorable feel or "image."

Material with a (sufficiently) pleasing aesthetic form has greater potential for conveying a particular message than does unesthetic material. The sender's choice of graphical form will generate either positive or negative expectations in the receiver, while the choice of typography and layout can often give the reader a pre-understanding of the message's content. In other words, it is important that a visual message exhibit good legibility, or, if it is a spoken message, distinctness. The message may be aesthetically pleasing, but its content is more important than its form.

Credibility of the message

It is quite obvious that different specimens within a medium, such as individual newspapers, books, television programmes, movies, records etc, will differ widely in their credibility depending on the contents of the various messages. Thus the credibility of the message is influenced by the credibility of the specific medium; and the credibility of the medium is influenced by the credibility of the message. The same message will be perceived in different ways in different representations. And the same kind of interactive influence can be seen between

the representation and the sender. Fleming and Levie (1978) noted that (page 203): "The receiver's evaluation of the message will affect the receiver's evaluation of the source." Thus an effective message has to be both credible and to merit credibility.

And Bettinghaus and Cody (1987) stated (page 100): "What sources say is extremely important, but how they say it and how they behave while saying it does dramatically affect the receiver's perceptions of the source, thus influencing the extent of attitude change the receiver is likely to experience."

What is typical for a message with high credibility? In my opinion it must be possible to understand the message and to be able to believe that the information is correct. The information can not be too divergent from the usual situations. Furthermore a high credibility message has a good structure, convincing arguments, proper references, and relevant examples. It is also a major advantage if text and pictures have good legibility as well as good readability. In my view a picture used in information materials should depict reality in a manner appropriate to the content and be as relevant and credible as possible. However, many pictures in textbooks and newspapers have been edited in order to change their importance and impact. The pictures can easily be enlarged or reduced in size, which will influence readability. It is often very easy to crop the original picture. However, cropping is not merely an aid to art or to journalism; it may also be a tool for unscrupulus editors. Many photographs lend themselves to manipulation of the representation of the truth. They are susceptible to different crops to support different meanings and various ideas. It is also possible to expand the original picture. Parts of the picture can be deleted, added, altered, moved or changed in shape. A colour can be changed, removed or added. This practice of editing is often unlawful. The picture's expressiveness can also be altered by the choice of method for reproduction and printing and the choice of paper or other materials.

Still as well as moving photographic images are not always imprints of what actually was in front of the camera. Movie productions often use special effect scenes created with a blend of techniques. Digital manipulation of images has now reached a point where it is often impossible for viewers to see what has been altered and what has not. Fetveit (1997) suggested that our trust in film imageswill be a product of institutional warrent rather than blind faith in the documentary power of photography. To some extent trust will pass from the photpgraphic technology to the institutions and to the discourses where the images are used. When people view movies like Jurassic Park and Independence Day they are not likely to believe that these actually are true stories. Here the purpose is entertainment and not information. The intentiion is not to present a representation of the "real world" but to present a representation of an "imagined world", a fantasy or a dream. In such a situation a manipulated image may employ high credibility.

The use of misleading illustrations in comparisons and statistics reduces the credibility of the message itself. According to Tufte (1983), misleading or lying graphics cheapen the graphical art everywhere. When a chart on television lies, it lies tens of millions of times over; when a major newspaper chart lies, it lies hundreds of thousands of times over to a great many important and influential readers. Tufte offers six principles which will result in graphical integrity (page 77):

- The representation of numbers, as physically measured on the surface of the graphic itself, should be directly proportional to the numerical quantities represented.
- Clear, detailed, and thorough labeling should be used to defeat graphical distortion and ambiguity. Write out explanations of the data on the graphic itself. Label important events in the data.
- Show data variation, not design variation.
- In time-series displays of money, deflated and standardized units of monetary measurements are nearly always better than nominal units.
- The number of information-carrying (variable) dimensions depicted should not exceed the number of dimensions in the data.
- Graphics must not quote data out of context.

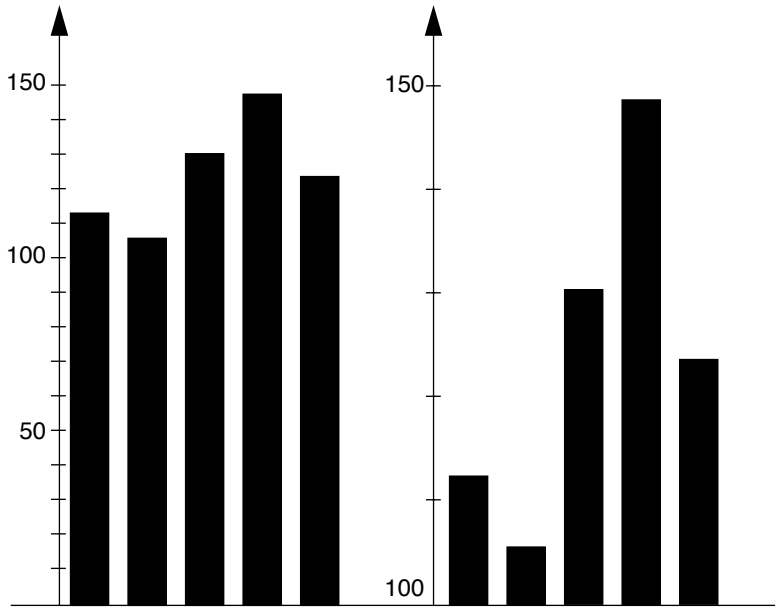

Figure 3. Different impressions. The two bar graphs in this illustration contain the same numeric information, but they give us different impressions. The graph to the right is easily misleading. It is an "unfriendly" graph.

Good designs are intriguing and curiosity-provoking, drawing the viewer into the wonder of the data. Tufte (1983) noted that graphical competence demands three quite different skills (page 87): the substantive, statistical, and artistic. Yet most graphical work today, particularly in news publications, is under the direction of but a single expertise-the artistic. Allowing artist-illustrators to control the design and content of statistical graphics is almost like allowing typographers to control the content, style, and editing of prose. Substantive and quantitative expertise must also participate in the design of data graphics, at least if statistical integrity and graphical sophistication are to be achieved.

Credibility of the context

In the receiving of a verbo-visual message, all receiver processes are influenced by prior experience in relation to age and gender, as well as by cultural, economical, historical, political, religious, and social factors. Such experiences in the social context will influence our individual selection processes, our mental process, and our response processes. The influence of these factors have a major influence on how various receivers relate to verbo-visual messages of different kinds, and on how meaning is subsequently constructed (Pettersson, 1996). Photographers documenting the horrors of war have sometimes been rejected because their photos "can not be true." And it is not possible for ordinary people to believe in them. It is clear that the context in which a message is received will influence the credibility of the message as well as the medium and the sender, and vice versa.

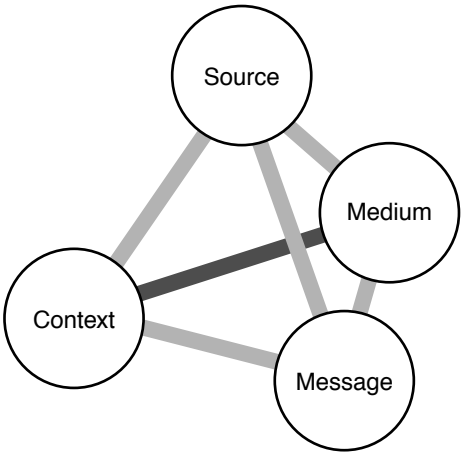

Figure 4. Credibility can be related to source, medium, message content, and context. These components all influence one another.

There is also an internal context. Within a medium credibility may be influenced with the help of typography, layout, sound and sound effects. For example, different placements of a message within a newspaper may influence the credibility of that specific message. For many people textbook authors are "high-credibility" sources. People believe in them. However, throughout history the use of pictures in various media has always been highly subjective. Many readers and viewers may not understand that all pictures that are used in various media often have been subject to selection, sometimes several times.

In the production of pictures in a textbook the author produces a manuscript and often also ideas for illustrations. The editor develops some ideas to picture descriptions and orders drawings and photographs. Artists deliver the drawings. Photographs are delivered by photographers and from picture archives. Pictures are selected, edited and produced. The readers make the final selections in the printed book. In the production of pictures in a paper specific event are presented with text and pictures and cause individual interpretations. The photographers selects among various possible motives and, later among the prints. Editorial staff make a selection among the prints, and produces text. The readers make their selections among the printed information.

Evans (1978) noted that a sequence of photographs may add credibility to a central picture (page 175). One way of "manipulating" and effecting the interpretation of image content is the careful writing of captions (Pettersson, 1986). Views expressed in the captions regarding the messages in the pictures may vary from very negative to very positive. Thus the captions will influence what the readers actually select to "see", or rather "interpret" from the contents in the images. Lidman and Lund (1972) claimed that a combination of a drawing and a photo will aid credibility. They wrote (page 30): "Through the drawing we understand the photo, through the photo we believe the drawing." Thus the drawing would influence our perception of the photo, and vice versa. This may very well be true in some situations. The context may also be external, directly outside the medium, i.e. the communications situation. Here different situations may influence the credibility of the message.

Conclusions

It may be concluded that the credibility of pictures are dependent on the perceptions and interpretations of the receivers, and not necessarily on any actual characteristics of the senders or sources. People does not seem to realize that pictures seen in media are selected and edited, and only represent a "fragment" of reality. It is possible that people often believe that image content is "true." The credibility of a picture is influenced by the credibility of the source, the message, the medium, and the specific context.

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From cave art to CAVE art

Abstract. *This paper provides some examples of early European visual language artefacts used for visual communication purposes. Examples include rock art, the Bayeux tapestry, early books, early data graphics, posters and wall charts, and the modern computerbased CAVE art.*

Although the term "visual literacy" may be modern, it is not at all a new idea or a new concept. Discussions about the use of images and pictures have a long history. Even ancient philosophers used images for visual communication. In anatomy and medicine, Aristotle employed anatomical illustrations. In mathematics, Pythagoras, Socrates, and Plato used visual images to teach geometry. Jesus Christ and other religious prophets helped their listeners create inner images by means of different metaphors. In Mesoamerica, the old cultures and civilizations used advanced pictorial messages, especially in their temple cities. Velders (1999) concluded that (p. 10):

> The history of visual communication goes back to the cave paintings 30,000 years ago, the description of it only 2,500. ... visual literacy is 2,500 years old (as a skill) and 30 years young (as a term).

A recent definition of the term "visual literacy" was provided by Avgerinou (2000). She used the following operational definition of visual literacy (p. 26):

> In the context of human, intentional visual communication, visual literacy refers to a group of largely acquired abilities, i.e. the abilities to understand (read) and use (write) images, as well as to think and learn in terms of images.

These abilities are not entirely new skills.

Pictures on rocks

Prehistoric rock art is art produced on rock surfaces by early nonliterate individuals. Rock art is found in Europe and in many other parts of the world. Dating techniques based on analysis of the pigments used by the prehistoric artists has shown that the dates vary considerably. Some rock art may be at least 30,000

years old. People were using different techniques and skills at the same period. The use of these skills did not relate to or reflect a successive development of art. Rock art include images that are carved, engraved, or painted on the walls of rock shelters and on the walls in caves, and on open-air rocks. In some parts of the world images were also painted or engraved on wood, bone, leather, egg-shell, ivory, and portable pieces of rock.

Figure 1. Rock art is found in many different parts of the world. Some rock art may be more than 30,000 years old. Maybe the creation of prehistoric rock art looked something like this diorama from a museum.

Human and animal figures were also modelled and sculptured from ivory, bone, clay, and stone. The best-known examples of prehistoric rock art are the Paleolithic cave paintings of Altamira, Lascaux, and other sites in southern France and northern Spain. They were discovered in the late 19th and early 20th centuries. These cave paintings are associated with the remains of the Cro-Magnon people. The images have been widely reproduced and are now familiar to the general public. Common motifs are buffalo, deer, reindeer, horses and other animals.

It is possible that rock art was meant to increase the hunting success and the fertility in the tribe. Rock images lack visual codes for perspective and they have no horizon. Sometimes the actual rock or the walls in a cave constitute a perspective. The prehistoric artists used yellow, red, brown and black pigments from dirt and soil, from ashes, calcium oxide and charcoal. They used animal fat, blood and urine as adhesive for the paints.

Figure 2. In Scandinavia, rock engravings on exposed glaciated pavements date to the Neolithic and Bronze ages, some 3,000 years ago. This picture shows some rock engravings in the province of Bohuslän in Sweden. The rock engravings were usually painted in red.

The available knowledge about rock art is increasing rapidly as this subject becomes a more acceptable and respected field of study within the social sciences. Rock paintings and rock engravings are still being found in new areas around the world.

The first "strip"

One of the most impressive visual stories was made as a remarkable textile, *The Bayeux Tapestry*. It is actually embroidery which depicts the Norman conquest of England by William the Conqueror in 1066. This important historical and cultural document is 70 metres in length by 51 centimetres in height (230 feet by 20 inches). It is executed in coloured worsteds on linen.

The Bayeux Tapestry is a visual narrative, a "strip." It uses 79 consecutive scenes. The central part of the strip contains scenes beginning with the English King Harold II's visit to Bosham and ending with the English fleeing in the Battle of Hastings in 1066. The Bayeux Tapestry incorporates a form of Latin subtitling which is placed within the image area.

The decorative borders above and below the main narrative show associated events, animals and scenes from fables. The embroidery has been partially restored and it may now contain portions that are not entirely faithful to the original. The Bayeux Tapestry may be the best-known example of historical graphical reporting. It is now housed in the Musée de la Reine Mathilde, Bayeux, France.

Pictures on ceilings and on walls

In many European medieval churches there are pictures, telling the churchgoers various narratives from the Holy Bible. These pictures cover the interior walls, partitions, and ceilings. They may be large and magnificent paintings in *buen fresco* as in the Basilica of San Francesco in Assisi, Italy. Here the frescoes were made by the greatest painters of the 13th and 14th centuries.

The pictures may be paintings in *fresco secco* in a popular and sturdy style as in the church of Härkeberga, Sweden. The artist Albertus Pictor (c 1445 – c 1507) used woodcuts from *Biblia Pauperum* as inspiration and originals when he decorated Härkeberga church as well as some other 35 small countryside churches in Sweden in the latter part of the 15th century.

Figure 3. This is a detail of a painting by Albertus Pictor in fresco secco on the ceiling of Härkeberga church, Sweden. To the right we can see how the whale is prepared to swallow Jonah. To the very left the whale has spat him out.

The pictures can also be overwhelming and expensive golden mosaics with millions of pieces of glass in beautiful colours, as those seen in the Basilica of San Marco in Venice, Italy. Here, many unknown fine artists worked for some hundred years to complete all the decorations.

All the pictures in the medieval churches were very important for the members of the congregations, especially since the preachers typically delivered their sermons In Latin, a language unknown to most common people also at that time.

Pictures in early books

The ability to print images on paper was achieved in Europe in the 14th century. The block book contained text that was written by hand but had printed images, coloured by hand. These printed images invariably included some form of captions or texts. When the moveable type was introduced during the 15th century, it became possible to produce books in larger quantities. This was the beginning of a cultural revolution. A dramatic growth in the quantity and quality of books and other printed learning materials like maps followed. Informative drawings developed.

"What writing is to the reader, pictures are to those who cannot read," stated Pope Gregory the Great (540–604). Already by the Middle Ages, a wide spectrum of image types was used for teaching and training purposes. The pictures ranged from realistic drawings to abstract diagrams. Pictures were used for the identification of important medical herbs, for instruction on how to load and use a cannon, how to swim, how to fight with a sword, how to construct a building, and for training the art of angling. Manuals and instructions from the 15th century and onwards are preserved. Mijksenaar and Westendorp (1999, p. 21) mentioned a fencing manual by Hans Thalhoffer (1443) that includes visual instructions in wrestling and unarmed combat.

The industrial production of books is a comparatively modern phenomenon. Despite the fact that books began to be printed more than 500 years ago, printing remained an exclusive and painstaking handicraft for many years. Gutenberg's bible for example was printed on 316 pages and took three years to make (1452–1455) in an edition comprising 200 copies. Some 170 of these copies were printed on paper and 30 on parchment. A total of 5,000 calfskins were required for the parchment versions. One goatskin was needed for the cover of each book.

Transmitting a message from an author to the readers requires people such as text and picture editors, graphic designers, typesetters, repro technicians, printers, bookbinders, stockroom staff, salespersons, order takers, bookstore employees, librarians, buyers, and administrators.

The different steps involved in publishing are still time-consuming and jointly represent a major expense. About ten percent of the price of a book, not including tax, usually goes to the author. Electronic publishing may change this situation to some extent. That would reduce the distance between authors and readers. New opportunities for a dialogue might then develop in some instances.

The Renaissance

The development of moveable type was very important for the production of printed text. But the new printing technology impaired the possibilities for close integration of words and visuals into verbo-visual messages. In manuscripts it had been easy to put words and visuals anywhere on a page. There the skills of integrating words with visuals were gradually developed. Many famous naturalists and explorers had relied on making verbal as well as visual notes of their findings. However, with the exception of private notes, words and visuals were now basically separated until the development of desktop publishing in the late 20th century.

A Renaissance artist and genius

The most noticeable example may be Leonardo da Vinci (1452–1519). He was one of the greatest artists of the Italian Renaissance. He entered the painters' guild in 1472 and in his Florentine workshop acquired a variety of skills. Leonardo da Vinci became deeply interested in subjects like anatomy, biology, engineering, mathematics, mechanics, and physics. He displayed genius in almost every arts and sciences and his notebooks are filled with sketches of anatomical studies, animals, and machines. The manuscripts reveal that da Vinci explored virtually every field of science. Not only do they contain solutions to practical problems of the day, but they also envision such future possibilities as flying machines and automation.

Nearly 7,000 pages from his notebooks still exist. Leonardo da Vinci sketched drawings of ideas and inventions along with his verbal notes. He was left-handed and he used mirror writing in his personal notes. But with the help of a mirror his scripts can be read clearly. Another unusual feature is the new function he gave to illustrations. He formulated his own principle of graphic presentation, which he called "dimostrazione" (demonstrations). He gave precedence to the illustration over the written word. The text served to explain the pictures. Leonardo da Vinci was clearly a precursor of modern verbo-visual communication and of modern scientific illustration. His notes, however, were probably not seen by any large audiences.

The majority of Leonardo's technical notes and sketches make up the *Codex Atlanticus* in the Ambrosian Library in Milan, Italy. At an early date they were separated from the artistic drawings. Some 600 of these documents now belong to the British Royal Collection at Windsor Castle.

The father of anatomy

Another early example of a person engaged in advanced and skilled graphic presentation is Andreas Vesalius (1514–1564). Vesalius was born in Brussels and became a professor of anatomy in Padua. He revolutionized the study of biology and the practice of medicine by his careful verbal and visual description of the anatomy of the human body. Andreas Vesalius is therefore often called the "father of anatomy."

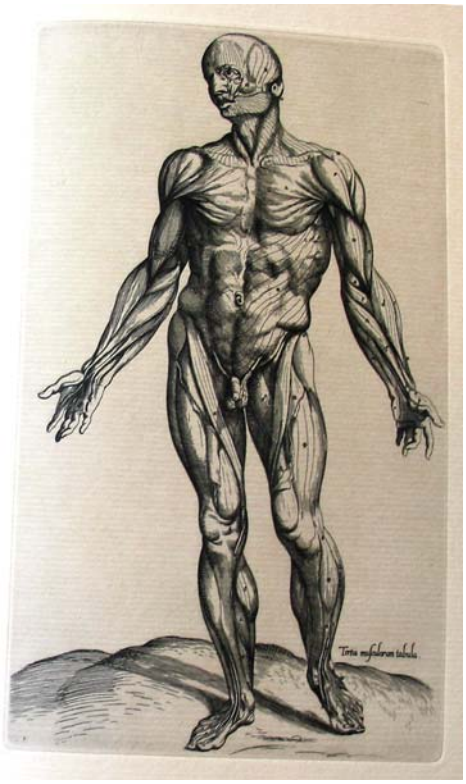

Figure 4. The 300 illustrations in the Fabrica provide a graphic, detailed record of the musculature and skeletal framework of the human body. These detailed anatomical illustrations became standards for a long time. This figure is from a 1964 facsimile edition of the 1543 book. In the book this illustration is 33.5 x 18.6 cm.

Rather than accepting many of the previous observations of anatomy, Vesalius took a straightforward scientific experimental approach. He initiated the use of dissection as an active teaching aid and compared the anatomy of various animals with humans and noted the fallacy of extrapolating from one individual to the other. Based on the observations of the pioneering dissections of human cadavers he did in Padua and Bologna, he wrote the first comprehensive text-

book of human anatomy, *De humani corporis fabrica libri septem* (The Seven Books On the Structure of the Human Body). This book is now known as the *Fabrica*. It was first published in Basel in 1543. A second edition was published in 1550.

The many careful descriptions of human anatomy helped establish modern observational science. The *Fabrica* was the first book to contain accurate depictions of the human anatomy of bones, muscles, blood vessels, nerves, internal organs, and the brain. In this book, art and anatomy are dramatically combined. The 300 woodcuts in the book were probably illustrated by Johann Stephan van Calcar (1499–1546 or 1550). He was a student of Tizian (1477–1576), who was one of the most talented artists of this time.

The first picture book for children

The first person to really show to a broader audience how visuals and words could interplay was the bishop Johannes Amos Comenius (1592–1670) of Moravia (later a part of Czechoslovakia). His wanderings brought him into contact with some of the intellectual leaders of Europe, especially in Germany, Poland, Sweden, England, and Holland. Comenius forged a philosophy that emphasized political unity, religious reconciliation, and educational cooperation. This philosophy presented the goal of education as the development of universal knowledge among all people, including women and children, and all nations.

Comenius' illustrated textbook, *Orbis Sensualium Pictus* (The Visible World in Pictures), was first published in 1658. Comenius presented information on the world and on mankind in closely related pictures and words. Through 150 illustrated chapters the book was designed to teach the student Latin with the help of short, but memorable sentences in the child's own tongue.

Considered by some scholars to be the first picture book for children, the Orbis brought into the home a complete world, combining subjects and modes of life from near and far. Comenius sought to strengthen the learning of linguistic symbols by visual means. Sensible things are suggested by representative images, non-representative visual devices (i.e., pictorial signs), and by words (i.e., verbal symbols). Creatures and artefacts are shown and named. Pictorial signs and verbal symbols indicate ideas.

The illustrations had numbers referred to in the text. In some later editions, the text was printed in four different languages. This book was widely used in both Europe and the USA for some 200 years. The first American edition was published in 1810, with texts in Latin and in English.

Many authors of ABC-books have later adopted Comenius' famous illustrated alphabet, combining letters, pictures, and "sounds" found in the opening pages. In *Orbis Sensualium Pictus* the illustrations are actual teaching devices

and not merely ornaments on the pages. Thus Comenius preceded Diderot's picture-volumes and the visualized fact books of today.

Comenius' conclusion, that nonverbal communication between parent and child both precedes and forms the basis of later language acquisition and development, is still considered a sound tenet of the theory of visual language (Reynolds-Myers, 1985; Sinatra, 1986; Moriarty, 1994). Moriarty noted that (p. 15): "Child development scholars would agree that visual communication skills are not secondary, derivative, impure or peripheral and, in fact, develop earlier than verbal skills in children."

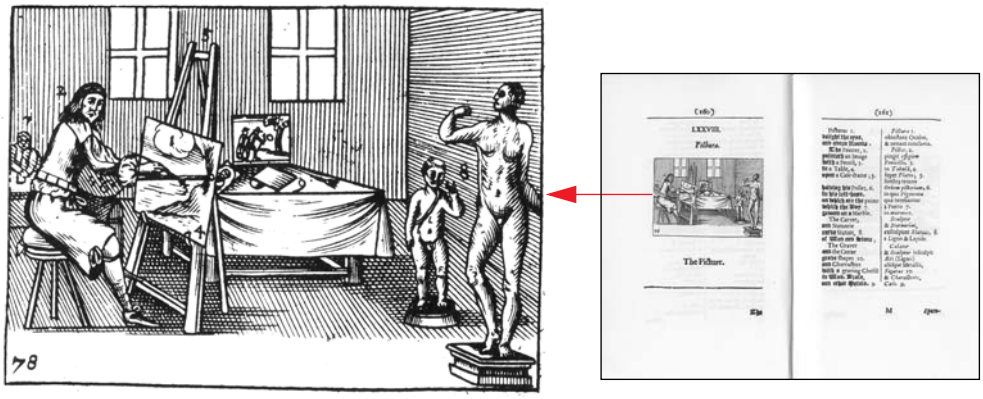

Figure 5. Pages 160–161 from Orbis Sensualium Pictus. The topic is "The Picture." These photos are from a 1970 facsimile edition of the 1659 edition in Latin and English. The picture is 5 x 7 cm. Orbis Sensualium Pictus is generally considered to be the first illustrated schoolbook which is designed specifically for children.

A botanical collection

In the 17th century major artists such as Peter Paul Rubens, Rembrandt, and Nicolas Poussin illustrated many books. In Sweden, Olof Rudbeck senior (1630–1702) and Olof Rudbeck junior (1660–1740) both worked on a gigantic project, *Campi Elysii*. Staff members were trained, and they produced a botanical collection with engravings of 6,200 plants. Unfortunately most of the wood blocks were destroyed in a fire. Another example from Sweden is the naturalist Carl von Linné or Carolus Linnaeus (1707–1778), who established the modern method for naming plants and animals. During his many journeys Carl von Linné made drawings as important complements to his written notes.

La Grande Encyclopédie

The greatest early enterprise in visual information and in message design is the French encyclopaedia *La Grande Encyclopédie*. The first volume appeared in 1751 under the co-editorship of Denis Diderot (1713–1784) and Jean d'Alembert (1717–1783). The Encyclopédie was a huge undertaking that occupied Diderot as chief editor for a quarter of a century.

The Encyclopédie exerted great influence throughout the world. It was a genuinely progressive work with 17 volumes of text, supplemented by 11 volumes of illustrations. The Encyclopédie included 71,818 articles. No less than 3,300 plates with detailed illustrations were designed and printed from copper engravings.

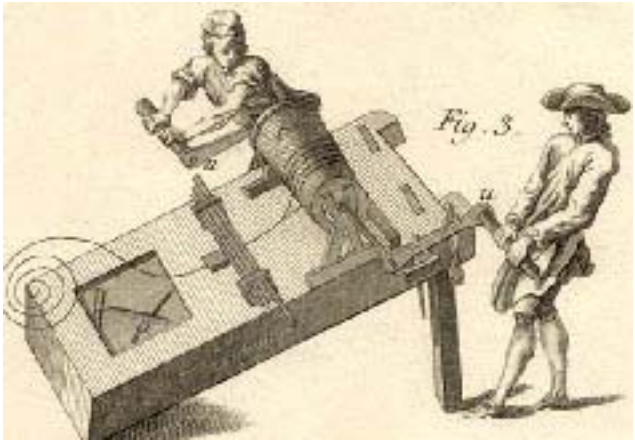

Figure 6. The Encyclopédie included no less than 3,300 plates with detailed illustrations were designed and printed from copper engravings. This is a detail.

The structure of the encyclopaedia was based on Francis Bacon's classification of universal knowledge, the most complete and systematic inventory of areas of knowledge and human achievement at that time. This assured representation of topics across the entire spectrum of knowledge. Leading persons such as Rousseau, Turgot, Montesquieu, and Voltaire wrote articles for the encyclopaedia. The general attitude was tolerant, liberal, and above all, rational.

Also today, combined verbal and visual information is very important in the natural sciences. In engineering, science, and business, clear thinking is often synonymous with visual thinking. Horton (1991) noted that Albert Einstein and several other highly valued thinkers relied on visual images. Moore and Dwyer (1994) stated that visuals may be the main source for information and communication in many cases today .

Early data graphics

The Napoleonic Wars were those wars waged between France under Napoleon I and various combinations of European nations from 1803 to 1815. They were a direct continuation of the French Revolutionary Wars (1792-1802). With overwhelming numbers the Allies finally defeated Napoleon.

One of the best-known graphic diagrams ever made is one made by Charles Joseph Minard in 1869. This graphic explains Napoleon's problematic march to Moscow and back. Here Minard (1781 – 1870) combined statistical data with a time-line treatment. Minard plotted six variables, showing the size of the French army during its advance and its retreat, its location on a two-dimensional surface, the direction of the army's movement with reference to places and time, and the freezing temperature on various dates during the retreat from Moscow.

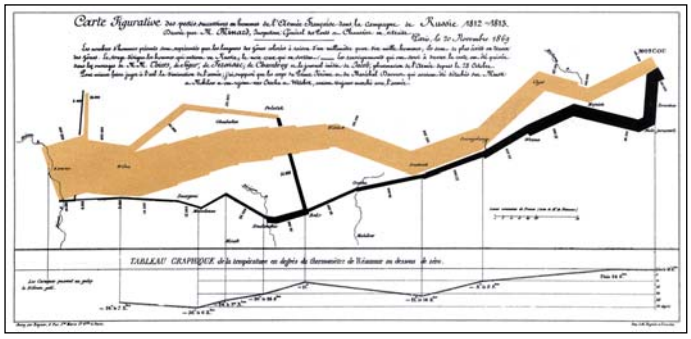

Figure 7. A very small version of Minard's double graphic depicting Napoleon's Russian campaign (1812 – 1813).

Beginning at the left on the Polish-Russian border, near the Niemen River, a thick band in the diagram shows the initial size of the army. Forces numbering more than 422,000 men invaded Russia in June 1812. The decreasing width of the band in the graphic indicates the declining size of the army at each place on the map.

The Russians retreated until they reached Borodino. Both sides suffered staggering losses in a battle there on September 7, and the Russians withdrew. Napoleon occupied Moscow on September 14, but Russian arsonists burned 80 percent of the city. The French evacuated the city on October 19, pursued by the Russian army.

Despite overwhelming Russian forces and bitter cold, Napoleon escaped encirclement at the Berezina River and managed to withdrew from Russian territory with what was left of his starving army. Only about 40,000 soldiers survived Russia. Finally only 10,000 men returned back into Poland from this devastating campaign.

Edward Tufte (1983, 1990, 1997), author of three impressive books on the visual display of data, calls this statistical graphic possibly the best one ever drawn. Tufte noted (1983, p. 40): "Minard's graphic tells a rich, coherent story with its multivariate data, far more enlightening than just a single number bouncing along over time."

Pictures on posters

The term poster was originally used (about 1838) in England to refer to a printed sheet of paper that combined text and illustration. Posters were displayed in public places as announcements or advertisements. The design of these early utilitarian posters gradually became more ambitious as they began to compete against each other to catch the public's eye for commercial, promotional, or political reasons.

The father of the poster

As early as 1858, Jules Chéret (1836-1932) created his first lithographic coloured poster in a characteristic, sweeping style. Ten years later, he returned to France after a seven year long stay in London, bringing modern English printing presses with him. Chéret started his production of posters on a large scale. Printing up to 10,000 posters per hour was realized, and at a very low cost. Chéret drew his posters directly on litographic stones. He concentrated on theatre posters and developed a unique, playful, and pleasurable style by connecting the text to the picture in a completely new way. Chéret concentrated the message in a big, central comprehensive picture, in order to accomplish maximal effect and visual impact (Hardy, 1986).

Jules Chéret is often called both the *father of modern advertising* and the *father of the poster*. Circus posters and their tradition probably inspired Chéret. On his posters, however, texts and illustrations play just as important roles. Texts and pictures complement each other being inseparable parts of a common graphical whole. They are also a whole from the point of view of contents. The words announce the contents, and the picture – often dominating the poster – describes the contents in the least little detail. As time went on, Jules Chéret formed the actual words as illustrations. All in all, he produced about 1,200 posters.

Broido (1992) has listed 1,089 of these posters in an illustrated catalogue. Above all, Chéret has created and conveyed the picture of the charm, elegance, and vanity of Paris–a myth that several imitators have further developed and that still prevails today. However, the Chéret posters advertise many different types of products and services.

Figure 8. Jules Chéret created a large number of posters. "Saxoléine PÈTROLE DE SURETÈ" (124 x 87 cm) was published in 1895.

The king of posters

Henri de Toulouse-Lautrec (1864-1901) was inspired by the use of effective colours in Japanese woodcuts. He worked with an expressive line and with strong colour centres in his posters. The pictures on the posters are metaphors, composed of hints and symbolic details. The words that fill the space between the different parts of the picture are there only in order to explain the picture. The function of the pictures is to tell something, without dominating the text. Toulouse-Lautrec's posters of actors, singers, and cabaret artists may be seen as the European equivalent to the popular Japanese woodcuts of actors, flirts, geishas, and wrestlers.

Toulouse-Lautrec, *the king of posters*, revolutionized the art of posters and gave the commercial poster the status of an independent art form. A register of his complete works shows all 350 lithographies, of which about 30 are posters (Arnold, 1990). A dozen of these are among the best ever produced in everyday art.

The 27-year-old Toulouse-Lautrec became famous overnight, when his poster "Moulin Rouge: La Goulue" was put on walls and advertising pillars all over Paris in October, 1891. The Moulin Rouge poster is one of the most well-known posters in the history of art. Here, Toulouse-Lautrec works with a great simplification. It was a very unusual composition at that time with figures partly within and partly outside the picture, some figures as silhouettes towards a

lighter background, and a linear contouring of different surfaces. The poster is the result of abstraction and simplification processes in several steps.

Figure 9. Toulouse-Lautrec portrayed several artists. MOULIN ROUGE La Goulue (c 191 x 117 cm) was published in 1891. It was printed on three separate sheets of paper in four colors.

Today, we tend to remember the artful and spectacular posters from the end of the 19th century, with advertisements for theatrical performances, cabarets, and restaurants that Chéret, Toulouse-Lautrec, and other artists created. However, at the same time there were a lot of posters that advertised everyday articles. These posters were printed in large editions, and their messages reached many people. The average cost for contact was negligible. No article or product was too simple or too cheap not to be advertised on a poster. The artists that created these posters with everyday messages for everyday products are more or less forgotten. Many of them were anonymous and worked quietly, without any attention.

During the 20th century, new printing techniques were developed. The poster of today is printed with silk-screen-printing or with offset techniques,

which makes it possible to use photographs as well. The constant influence by different mass media today heightens the demands on us to perceive the message in posters as quickly as possible. Therefore, today's posters have to be even clearer, simpler, more distinct, and more effective than the posters from the turn of that century.

Teaching aids

During the 19th century, textbook visuals were often placed vertically to provide better use of page space. Often, one picture was used to depict different persons or towns. Visuals were often a kind of "painting" with little or no real interaction with the text. In most books, pictures served primarily as an artistic supplement to the text.

However, visuals have been used in a more intentional way in non-fiction books. As early as in the Middle Ages, some secular texts were illustrated. Medical science, for example demanded knowledge of herbs and plant recognition and was improved by clear and analytical drawings as early as in the 5th century. Colour, when used, was true to life. Each illustration had a text under it, stating the characteristics of the herb and its medical use. However, copies made from earlier manuscripts, rather than from living plants, ultimately transformed the illustrations into stylised forms – very different from the botanical reality.

Figure 10. Wall charts were the main visual aids in education during the first half of the 20th century. They are still used in many countries. In Sweden the artist Nils Tirén documented the wild life with a series of 80 pictures. They were published from 1917 until 1935. The title of this wall chart is "Wolf."

Wall charts, mounted photographs, some posters, picture collages, wall maps, and roller blind-type maps are usually excellent teaching aids, if they are relevant to the context and large enough for the audience to see distinctly. Sometimes wall charts include combined verbal and visual messages.

From an instructional point of view, there was not much development in visual instructional language from the 15th until the 20th century. Mijksenaar and Westendorp (1999, p. 22) concluded that: "The next major advance in visual instructions occurred during World War II, when the military used pictorial language to train soldiers. The Walt Disney Company, for instance, adapted its cartooning skills to create training documentation and films such as the movie employing Mickey Mouse to explain how to use a Browning.50 water-cooled machine gun. The defence industry in general also played a role in augmenting and applying visual instructional language during this period."

The age of information

In the industrialized part of the world we are living in mass-media societies. Every day we are bombarded with information via the media, at home, in school, at work, and in society in general. It is rather hard to avoid information and it may be just as hard to obtain the information that we really need at the time. Audio, text, and visuals compete to get our attention. It is quite possible that we miss the information in which we are really interested. In addition to radio, television, books, newspapers, and magazines, vast amounts of information are distributed in the form of letters, advertising flyers, posters, placards, photocopies, and photographs.

Throughout the 1980s, major changes occurred in the way our society produced, stored, processed, and accessed information. Monfils (1993) noted that regardless of the specific application of technology, consensus had been reached on the increasing impact of modern information technology on all aspects of our lives. The amount of information that is available to most people is seen as increasing every day. Modern research and development produce more information than ever before. Our society views the availability of, and the need for information as the basis for decision-making as continually increasing. Quite frequently, people in a variety of occupational settings find that their basic knowledge is inadequate.

We can easily learn a little about a great many subjects. However, this kind of learning leaves us with little more than a broad base of superficial knowledge. For some people, the ultimate goal actually seems to be to know a little something about everything, resulting in an altogether fragmented knowledge base. In an information society, everyone should have the right to access needed information. Even though most people may be able to distinguish the sometimes-

biased opinions presented by some media, not all are able to find the objective information that they really need. We need to learn to locate, access, evaluate, process, understand, and use information. We also need to learn how to handle various new situations in the "Age of Information."

WWW

The pace of development is likely to increase rather than decrease in the future. It is possible that visual messages, and verbo-visual messages, in different forms will become increasingly important in the future when modern information technology like multimedia and the World Wide Web (WWW) are common to many people.

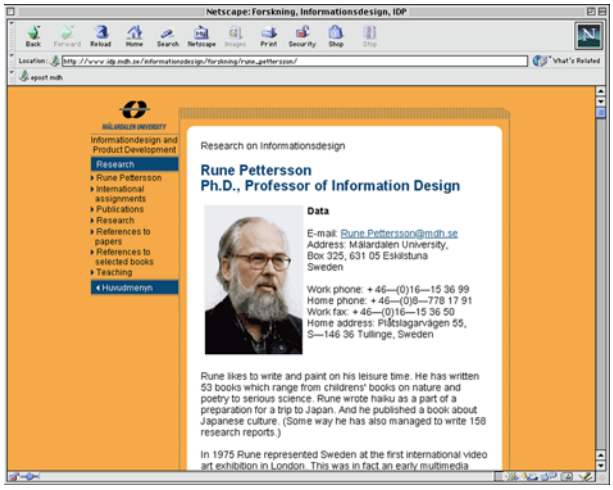

Figure 11. This is an example of a WWW-page on the Internet.

Modern systems for information technology often have user interfaces based on symbols and images. These systems are intended to function in various countries, in various cultures and subcultures. Enser (1995) noted that we now belong to a society experiencing technological advances that promote the importance of the visual medium for message transmission and knowledge representation. I agree with Enser that this is a paradigm shift offering both opportunities and challenges, especially for the education and information professions.

I also foresee two other paradigm shifts. In the future, we will focus on the information content rather than on the printed documents as such. We will also see a shift from emphasis on teaching to emphasis on learning. And Malmberg (1996) pointed out that the culture industry transforms pleasure into mere enter-

tainment and a "society of entertainment" is emerging. Here, the civic duty is to keep smiling and have fun with others.

The new CAVE

The CAVE (Cave Automatic Virtual Environment) is a virtual reality system. Beier (2003) defined it as a multi-person, room-sized, high-resolution, 3D video and audio environment.

Inside a 10x10x9 foot theatre people use lightweight stereo glasses. Viewers may be completely surrounded by 3D computer graphics projected in stereo onto several or all walls, the roof, and the floor. People may move around inside the cube and explore the virtual world, an illusion of immersion. One user is the active viewer, controlling the stereo projection reference point, while the rest of the users are passive viewers. A sound system provides audio feedback. It is possible to "grab" objects with a three-button, wand-like device.

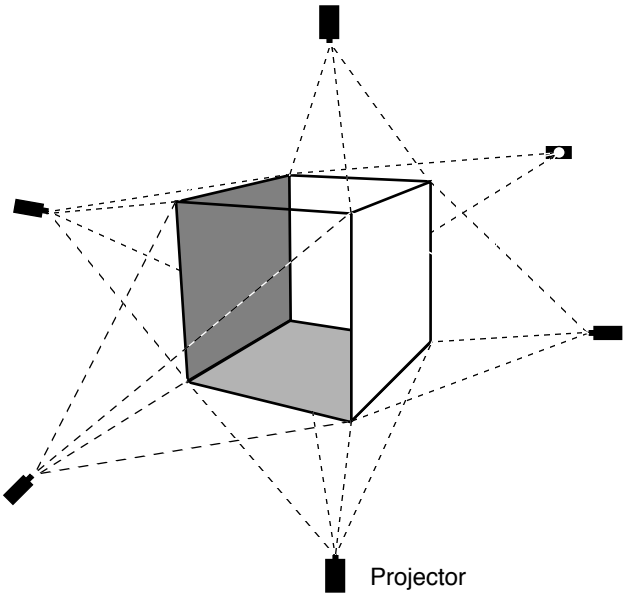

Figure 12. A schematic principle of the CAVE system.

The CAVE was developed at the Electronic Visualization Lab, EVL, at the University of Illinois at Chicago. EVL demonstrated the first version at the SIGGRAPH '92 conference as a useful tool for scientific visualization (CAVE, 2003). Today the systems are used in several countries for experiencing virtual reality art. The CAVE offers really exciting possibilities.

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Paper 10

Media and learning

Abstract. *There are many kinds of media research. However, in this paper only media research related to the availability of media and the use of media in teaching and in learning are briefly presented in the following sections: (1) Access to media, (2) Use of pictures in textbooks, (3) Media influences on learning, and (4) References.*

Access to media

An explanation for all the media hardware and software in schools, and the use of media in teaching can be traced back to the 1940s and 1950s. The "realism theories" include the iconicity theory (Morris, 1946), the cone of experience (Dale, 1946), and the sign similarity orientation theory (Carpenter, 1953). The basic assumption from each of these theories is that learning will be more complete as the number of cues in the learning situation increases.

It might be interesting to take a closer look at the actual *access* to media, and *use* of media. Sweden is used as an example in the following sections. In 1994, Sweden had 3.8 million households and a total population of 8.8 million people. In Sweden most people have access to mass media like radio, television, newspapers, periodicals, and books. In Sweden, 1.2 million children attend compulsory school and upper secondary school, taught by 133,000 teachers of which around two thirds (65%) are women (Statistics Sweden, 1995). They work together in more than 50,000 classrooms in 4,900 schools.

Metallinos et al., (1990) studied the use of textbooks in schools in Australia, Greece, Japan, Sweden, and the USA. There were both interesting similarities and interesting differences between the five countries. A follow-up study (Pettersson et al., 1991) focused on the teachers and their actual use of media and pictures in their teaching. A total of 178 social studies and geography teachers made 4,358 statements in a questionnaire study. To be able to compare the use of each medium (and each picture type) we ranked the use of media (and picture type), and calculated an "index of utilization". The media index range from 0 to 100 (Pettersson, 1990a). A medium that is used *every lesson* is assigned a media index of 100, *once a week* 50, *once a month* 25, *once a term* 12.5, and *never* has a media index of 0.

Results suggested that there is a substantial difference between different individual teachers. The blackboard and textbooks have the highest rank order. They are used every lesson in all five countries. As noted in the following sections many media are seldom used at all.

Blackboards and books

Even if publishers of school textbooks in many countries have experienced difficulties and have complained frequently about the decline in sales of textbooks, there are still a great number of books in school store-rooms and in classrooms. It is difficult to form a clear picture of just how many textbooks there actually are in the schools. In Sweden it seems reasonable to suppose that there is an average of 15 books per student. Then there would be 18 million books in Swedish schools. In addition, both students and teachers may use the school libraries. The estimated number of books in Swedish school libraries is 28 million. School library loans amount to 17 million per year, which is around 14 books per student per year. Local community libraries also lend books that are used for schoolwork (Statistics Sweden, 1995). During the latter part of the 1980s, the volume of information was growing at such a rate that conventional information storage and retrieval methods could no longer keep pace. Boyer (1987) noted that:

> Today, about one out of every four undergraduates spends no time in the library during a normal week, and 65 percent use the library four hours or less each week. (page 160)

This gap between the classroom and the library, first reported almost half a century ago, still exists for higher education. With the help of observations and long-term studies, Gustafsson (1980a, 1980b) and Sigurgeirsson (1990) have mapped how teachers use their time in the classroom. The result of both these studies, carried out in Sweden and in Iceland showed that textbooks were used more than anything else in the classroom, during 72% and 80%, respectively, of the lesson time. Textbooks were used both more often than anything else, and for longer periods. Sigurgeirsson found that 70-90% of teaching is based on teachers and students using textbooks and worksheets. The text received almost all the attention. The illustrations in the etxtbooks were almost never used as sources of information.

The second cross-cultural study (Pettersson et al., 1991) showed that the blackboard and the textbooks in geography had the highest rank order. In Sweden, this group of teachers uses the blackboard every lesson (index=93), or every day. The same applies to Australia (83), and to Japan (100), while in the USA this is not the case (58), nor in Greece (40). The geography teachers in Sweden used textbooks every lesson or at least once a day (index=88). At least once a week, these teachers used a school atlas (57), other books (56) and wall maps (48).

When Svingby et al. (1990) asked social studies and geography teachers in Sweden to what extent they used different media in their classrooms they got similar responses. For the study of geography and history, the textbooks were judged to be "important" or "very important" by around 80% of the teachers. Among 157 teachers, 60% used so called subject literature "once a week".

deLange (1996) noted that textbooks and chalkboards are the main media in schools in Southern Africa. The lack of electricity makes most other kinds of media obsolete. deLange wrote:

> Research in Third World countries and in Southern Africa, found that smaller classes, science laboratories in high schools and increasing teachers' salaries were some elements that did not raise pupil achievement. Increased educational expenditure on textbooks and libraries, which constitutes printed material, were some measures that raised pupils performance in classrooms (Mncwabe 1993: 216-218). (page 2)

And Schiffman (1995) concluded that while encumbered by challenges, textbooks and other print materials continue to be a primary format for educational materials. Unlike many new technologies, they can be easily tailored to the needs of special audiences. The general conclusion is that textbooks are, and will be important sources for verbo-visual information also in the future. We shall not make the mistake to "forget" the printed and copied media in the information age. At low cost blackboards, compendia and books provide an impressive degree of flexibility.

Overhead transparencies and slides

There is an overhead projector or a slide projector, or both, in most classrooms in Sweden (Pettersson, 1991). All schools have collections of overhead transparencies and slides. Some of these are series produced by publishing companies and other commercial producers, and other series are produced locally by the teachers themselves. The situation seems to be similar in many other countries.

Despite easy access, overhead transparencies and slides are not used very often during lessons. In accordance with Gustafsson (1980a, 1980b) and Sigurgeirsson (1990), besides textbooks, teachers seldom or never use any media other than overhead transparencies, and even these are used in only 6% (Gustafsson) and 7% (Sigurgeirsson) of lessons. The cross-cultural study (Pettersson et al., 1991) found that the social studies and geography teachers in Sweden used overhead transparencies (index=32) and overhead transparency maps (22) at least once per month. They also used slides (27) and film strips (21) at least once per month. However, in this study it was found that there were major individual differences between teachers in how much they used these media.

It was clear that some teachers never use any media at all (except for blackboards and textbooks), while others may use media quite often.

Radio programmes, sound tapes, and gramophone records

Radios are found in one out of two classrooms in Swedish schools (Forsslund, 1991). During 1992, Utbildningsradion (the educational wing of the Swedish Broadcasting Corporation) broadcasted 1,430 hours of school radio programmes (Carlsson and Anshelm, 1993). In other words, there was a significant number and variety of programmes for the teachers to choose from. Radio programmes may be used at the time of their broadcast, or may be borrowed later as sound tapes from the AV and teaching aids centres.

In accordance with a study in which 800 teachers responded to a questionnaire, only one third of them (36%) used any radio programmes in their teaching at least on one occasion during the spring school term of 1990 (Forsslund, 1991). Since many classes may have several teachers, it is not possible to estimate to what extent each student has access to radio programmes during lessons from this total figure.

In most schools, there are cassette players, tape players, and record players (Forss-lund, 1991). Many schools, and even some teachers, have their own collections of sound tapes, cassette tapes, and records. Sound tapes are used particularly in the teaching of the foreign languages and of music.

Gustafsson (1980a, 1980b) observed that sound tapes were used quite often in up to one fifth of the total lesson time (19%), for the teaching of English in the Swedish schools. During 1990, a total of 1,000,000 loans of sound tapes and cassettes were registered by the AV and teaching aids centres (Forsslund, 1991).

Television, video and film

Most schools have television sets (96%) and video cassette players (94%) in Sweden. Many schools also have video cameras (54%), but teletext is still relatively rare (11%) (Forsslund, 1991).

In 1992, Utbildningsradion broadcasted 125 hours of school television (Carlsson and Anshelm, 1993). These programmes can be used at the time of broadcast, or borrowed later as video cassettes from the AV and teaching aids centres. Some teachers record school television programmes themselves, and also other more general programmes, for use in their teaching. A few teachers also produce their own programmes with video cameras.

Forsslund (1991) found that only just over half of the teachers (56%) used television in their teaching at least once during the spring school term of 1990. In 1990, 140,000 loans of video cassettes were registered. This means that, distributed over the entire country, teachers used 2.5 video cassettes per class per

school year. Since many classes may have different teachers it is not possible to estimate to what extent each student is exposed to television or video programmes during lessons. The cross-cultural study (Pettersson et al., 1991) found that the social studies and geography teachers in Sweden used video cassettes in their lessons at least once per month (index=18) and they used school television programmes at least once per term (10). Svingby et al. (1990) got similar results. In their study most teachers (76%) used radio and television programmes "several times per term".

In accordance with Considine and Haley (1992), a study conducted by the Department of Education in 1988 found that eight graders in the USA spent 21.2 hours per week watching television compared to 5.5 hours per week spent on homework. In Sweden too, we can anticipate that children spend more time watching television than they spend on homework.

In Sweden almost all schools have access to 16-mm film projectors (Pettersson, 1991). During 1990, 500,000 loans from the AV and teaching aids centres were registered. This means that, spread over the entire country, teachers used 9.1 films per class. Since many teachers never use radio, television, or film in their teaching, it is likely that the teachers who do use these media use them quite often. The showing of films is, therefore, probably unevenly distributed over the country. The cross-cultural study (Pettersson et al., 1991) found that the social studies and geography teachers in Sweden used films in their lessons at least once per month (index=18).

Computers and other media

In Sweden most schools have computer rooms for teaching computer studies. Some schools also have modems, which make it possible to access information in traditional databases. However, the costs to access these databases are often prohibitive for the schools, so the use of this facility is very restricted. The cross-cultural study (Pettersson et al., 1991) showed that the social studies and geography teachers in Sweden used computer programs in their lessons at least once per term (index=4). Some schools are now exploring the use of multimedia and the World Wide Web. Several people express high expectations on the Internet and various experiments have recently started.

The cross-cultural study (Pettersson et al., 1991) showed that the social studies and geography teachers in Sweden used wall maps (index=48) at least once per week. At least once per month, they used newspaper and magazine articles (31). Svingby et al. (1990) also found that more than half of the teachers used newspapers and magazines "a couple of times per term", which is roughly once per month. They used flip pads (7) and charts (6) at least once per term.

Chalk talk

Many teachers in different countries spend most of their time in the classrooms talking to their classes (Gustafsson, 1980a, 1980b; Sigurgeirsson, 1990; P10, Pettersson, 1991; Ferrington, 1994). It appears that teachers generally teach the way they were taught, following the traditional approach to education, providing prepackaged information to students. Heinich et al. (1982) noted that students must be able to analyse the structure of a lecture to distinguish between relevant and irrelevant information. Students must be *information literate* to be able to learn effectively. The cross-cultural study (Pettersson et al., 1991) showed that the total average media usage in schools was surprisingly similar in Japan (37), Australia (32), Sweden (32), and the USA (30). In Greece (18), teachers were more conservative in their use of media in teaching than the teachers in the other countries in the study. Despite the fact that we live in the information society, and are witnessing rapid technological development, it is still *chalk talk* to a large extent that counts in the school environment.

In Sweden Skolverket (The National Agency for Education), which develops new curricula for Swedish schools, carried out a comprehensive study of schools. In this report, entitled "Bilden av skolan 1993" (A picture of the school, 1993), Skolverket concludes that Swedish students have good basic knowledge in many subjects. They are among the best in the world at reading and comprehending. They are good at mathematics and English as a second language, but they have remarkably poor knowledge in the natural sciences. They are also poor at solving problems and have difficulty in using their knowledge in an independent and active way. The fact that students have difficulty solving problems and understanding contexts reflects the school's way of teaching, the head of Skolverket, Ulf P. Lundgren, said in an interview (Ljunghill, 1993). The dominant method is still the traditional method of the teacher lecturing and students passively listening and answering questions. In Lundgren's opinion, teaching in Swedish schools is more conventional and traditional than in most other countries.

An active, investigative method of working, which the writers of the school curricula have advocated for more than two decades (since 1969), has not yet made any major impact on the school's daily work. The main impression one gets of the teaching in Swedish schools is that students passively receive what the teachers have selected for them, which primarily comes from school textbooks. The students get almost no practice in searching for information themselves or in solving problems. The introduction of the Internet may change this situation in the future.

It may be concluded that most teachers have access to different media. However, media is not widely used in teaching. Despite the rapid technological development teaching is still chalk talk to a large extent.

Use of pictures in textbooks

There are many pictures in textbooks and in other media. Do teachers and students use these pictures? To what extent are visuals used in oral presentations?

Mulcahy and Samuels (1987) provided an extensive history of the use of illustrations in American textbooks over the last three hundred years. They pointed out that only as printing technology has progressed, it has been practical for publishers of textbooks to be concerned with semantic and syntactic text parallels between the illustrations and the text. Putting the right pictures in the right places in a textbook is a concern that is rather new.

Textbooks influence a large part of the planning and the realization of the teaching. Research on texts, their language, style, meaning, and social meaning has a long history. In contrast to the extensive research on text processing, and text design, there has been far less research on the visuals printed in textbooks (Houghton and Willows, 1987; Mandl and Levin, 1989; Mayer, 1989; Willows and Houghton, 1987; Pettersson, 1993). According to Selander (1991) the analysis of a pedagogic text includes the text as well as the pictures and the interactions between these two "languages". A pedagogic text is created to work in education. A pedagogic text can be a textbook, but also practice material: a film, a series of slides or any other form of pedagogical resources.

Melin and Pettersson (1991) studied how captions and illustrations co-operated in three textbooks for junior high school. The captions did not fill the purpose they could have filled. Captions were seldom the "bridges" between illustrations and text which would ease the understanding of the text as well as of the pictures.

As far as pictures in textbooks are concerned it is interesting to know what portion of the page or the text-face is used for pictures and text respectively. Evans, Watson and Willows (1987) investigated 11,236 pages in Canadian textbooks. In the textbooks for the junior level of the compulsory school the pictures covered 60-80% of the pages. The figure was 50-70% in textbooks for the intermediate level, and 30-60% in textbooks for the junior high school. In many books for the junior and the intermediate level the pictures occupies such a large space that there is little or no space left for the text. The lack of space combined with the unwillingness to delete information might be one reason for compressed and hard-to-read textbooks. Evans, Watson and Willows calculated a *frequency index*, the percentage of pages with pictures. The frequency index was 90-100% in textbooks for the junior level, 50-70% in textbooks for the intermediate level, and 30-60% in textbooks for the junior high level.

Comparisons between old and modern textbooks often show that both the number of pictures, and the space for pictures have increased. Correspondingly the space for text has decreased. After the second world war the typical textbook author is rather a teacher than a person doing research (Selander, 1992). Nar-

rative texts have disappeared for the benefit of short, abstract, descriptive, and fragmentary segments of texts. During the years textbooks have more and more illustrations, and a new kind of layout. Berglund (1991) verified that for each generation the pictures of the textbooks have become more in number, larger, more elegant, and more colourful. An important reason for this is the need for the publishers to be sales oriented. Many colour pictures are used as a competitive means in the continous battle for more customers.

Modern textbooks often have a rich and varied graphic idiom, and they include many different types of pictures; such as colour photos, black and white photos, realistic drawings, diagrams, graphs, maps, collages, cartoons and caricatures. Thus, there are plenty of pictures of different kinds in today's textbooks, but how are they used, if they are used? Which attitudes have pupils and teachers to the pictures in the textbooks? To what extent are the pictures relevant to the text? A poll of teachers in Stockholm showed that they often consider the pictures in textbooks as "good", but that many pictures quite simply are "unnecessary" (Lingons, 1987). Less than half of the colour photos (43%), and drawn illustrations (43%) in the textbooks are interpreted as relevant to the texts. At the same time we know that colour pictures are very expensive to buy and to print, and they force up the price of textbooks. And often colour adds no pedagogical value to a picture.

Lindell (1990) summarized an extensive research on the public school system in Sweden, and also on the use of teaching aids. At several inquiries researchers asked pupils and teachers about "the pleasure of working with teaching aids". A "weighed mean value" for almost 12,000 pupils from 13 inquiries was 3.5 on a scale of one to five. The mean value for 567 teachers in ten inquiries was 3.2. Thus, pupils as well as teachers were satisfied working with the teaching aids available in the schools.

However, neither pupils nor teachers are very fond of working with all the pictures in the textbooks. In one inquiry (Holmberg, 1990), subjects ranked picture activities. "Work with pictures in books" got a very low ranking by both pupils and teachers. After several interviews Larsson (1991) observed:

> Whoever you turn to – teachers, pupils, artists, photographers, graphic designers, researchers – all seem to agree that the picture has a weak position in today's Swedish schools. (page 93)

This is probably also true in other countries. Evans, Watson and Willows (1987) noted that the attention-getting and motivational aspects of illustrations in textbooks seemed to predominate. In the classrooms, teachers made very few references to illustrations in the textbooks, and they provided little guidance in the educational functions that illustrations are thought to serve. Romare (1991) meant that the intended, overall function of pictures in textbooks is to visualise a content. The specific purpose of the picture can vary, you may want

to inform, influence, hypnotise, decorate and so on. Trotzig (1993) pointed out that illustrations in textbooks are extremely important means of communication. The pictures are often what first catch the reader's eye and the last things he forgets from his schooldays. One of my own studies, including 82 pupils (391 answers) and 40 teachers (84 answers), has shown that there are more than 150 different purposes with pictures in education. The ten most frequent purposes were: show (77), explain (44), visualise (25), illustrate (24), inform (21), summarise (21), make clear (18), convey (17), elucidate (16), and present (15). Levin and Mayer (1993), Mayer (1993), and Woodward (1993) all noted that although approximately one-third to one-half of the space in science textbooks is devoted to illustrations, most textbook illustrations do not appear to serve any important instructional function. In an extensive paper Sims-Knight (1992) reviewed 88 sources on the use of pictures in textbooks. She found that visuals can be effective in their educational function, even if they are unappealing or dull, as long as there is appropriate subject matter content.

In addition to these intended purposes, pictures can communicate unconscious messagea, values, and standpoints. The sex-typing of the modern society is often reflected in mass media as well as in textbooks. Neither women nor disabled people are seen here very often, they are hidden. Taylor (1979) found traditional sex-typing in teaching aids in England, Hilmo (1983) in Norway, Watford (1983) in the Soviet Union, and Beckius (1987), as well as Benckert and Staberg (1988) in Sweden. Benckert and Staberg concluded that text as well as pictures in a subtle way convey the message that girls are not fit for studying scientific and technical subjects. One explanation to the skew distribution between sexes in textbooks could be that the textbooks actually reflect today's real society in a better way than they reflect the curriculum objectives of an equal society.

In Sweden, a total of 164 teachers and students made 1,938 statements (Pettersson, 1990b). To what extent are visuals used for teaching? The findings may be summarized in the following main points:

- Today's textbooks contain numerous visuals in colour, have "modern" layout and compressed texts.
- The large number of visuals in textbooks has apparently had an adverse impact on the design and the structure of the text.
- Visuals may often possess emotive forces which are not easily foreseen.
- Comprehensive school students have a very poor pictorial capability. They are poor at reading and understanding pictures. They are also poor at expressing themselves in pictures.
- Both students and teachers need to learn how to use visuals.
- We all have to learn how to read pictures.

- Visuals in textbooks are used rather sporadically. Many visuals are "unseen".
- Visuals in textbooks are seldom used in an "active" manner.
- Visuals can always be interpreted in multiple ways. So, legends are needed to explain what is important and to indicate how pictures should be interpreted in each case.

It may be concluded that visuals in teaching aids must evoke responses in the reader. To make this possible, the reader must be able to discover the visuals, become interested in them and read them in an active and selective way. It may be good advice to teachers to learn about visual communication and always use pictures in an active way. In my opinion teachers should request quality, and refuse to buy expensive teaching aids with poor quality.

Media influences on learning

Few teachers use electronic media on a regular basis in their teaching. Gibbons et al. (1977) wrote:

> ... after honest efforts to use electronics media over an extended period of time, many teachers have been unable to see a clear improvement in learning. Hence, electronics media are generally judged by teachers to be inappropriate educational tools for most circumstances. (page 1139)

During the years, many researchers have argued that the use of media in teaching actually have no learning benefits. According to Clark (1983), the results of the studies that appear to favour one medium are actually not due to the medium itself, but to the method or to the content that is introduced along with the medium. Clark sees media as:

> vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition. (page 445)

Thus, the medium is an inert conveyer of an active stimulus, to which the learner makes a behavioural response. Clark (1994) concluded that in thousands of media research studies conducted over the past 70 years, researchers have failed to find compelling causal evidence that media or media attributes influence learning in any essential and structural way at all. Media and their attributes have important influences on the cost and the speed of learning, but only the use of adequate instructional methods will actually influence learning.

According to Clark, it cannot be argued that any given medium or attribute must be present for learning to occur, only that certain media and attributes

are more efficient for certain learners, learning goals, and tasks. Clark concluded that delivery technologies influence the cost and access of instruction and information, and that design technologies make it possible to influence student achievements. However, instructional designers, developers, and researchers often fail to link their work adequately to the basic and applied research on learning from instruction.

However, according to Kozma (1994), learning is not the receptive response to delivery of instruction. Learning is an active, constructive, cognitive, and social process by which the learner strategically manages available cognitive, physical, and social resources to create new knowledge. This is done by interacting with information in the environment and information that is stored in our memories. Reiser (1994) argued that Clark fails to acknowledge the fact that certain media attributes make certain methods possible:

> Returning to Clark's truck analogy, the successful delivery of frozen foods requires the use of a vehicle with refrigeration. (page 45)

Clark (1994) accepts Kozma's (1994) point that whenever learning occurs, some medium or mix of media must be present to deliver instruction. However, if learning occurs as a result of exposure to any media, the learning is caused by the instructional method embedded in the media presentation. Clark claims that media research is merely a triumph of enthusiasm over substantive examination of structural processes in learning and instruction.

Salomon, Perkins, and Globerson (1991) argued that media should focus on the effects of learners' cognitions with technology, as opposed to the effects of technology. We should see media as facilitators of constructive learning, instead of the conveyors of instruction. Instead of using multimedia to deliver instruction or even create environments for learning, multimedia are better used as environments or tools that enable learners to construct their own artifacts (Kommers, Jonassen, and Mayes, 1992; Lehrer, 1993).

According to Ross (1994), both Clark and Kozma may be right. From a positivistic perspective, Clark is correct in arguing that media studies are limited for isolating the instructional strategies or essential "ingredients" that cause gains in learning. But, from an applied perspective, Kozma is also correct in supporting the design of media-based delivery systems by systematically selecting and combining effective strategies/ingredients.

I support Jonassen, Campbell, and Davidson (1994) who advised a shift in the debate and a shift in the practice of instructional design from instruction- and media-centred to a learner-centred conception of learning. The debate should focus on the attributes of the human learner involved in learning, and on the role of media in supporting, not controlling, the learning process. Jonassen, Campbell, and Davidson concluded that the most important debate is not about the relative efficacy of instructional components; instead it is the role of

the learner and the context of learning. While learning, students interact with both media and methods, and it is difficult to isolate the effects of media from the effects of the methods. As previously noted Bjørgen (Kristiansen et al., 1994), advocate a similar opinion.

In my view the further education programme at the Norwegian University of Technology has been very successful. Based on experiences from the TVI-method, *Tutored Video Instruction*, that was developed some twenty years ago at Stanford University, a method of *team learning* supported by media has been developed in Norway. The TVI-method is based on the common-sense notion that students can learn more from a lecture if they are free to interrupt it at places where they need more discussion or explanation of a point or a concept (Gibbons et al., 1977). The TVI-method supports the communication processes by providing a tutor who acts as a catalyst between the individual learners. In various workplaces in Norway, groups of people engage in this distance education programme.

Each team receives video cassettes with recordings from ordinary lectures in the university courses. The members of the teams view these recordings, and interact in various group discussions and group activities. People are active and motivated to learn. Hebnes (1995) reported that 90% of the members in three teams (30 persons) preferred this kind of media-supported team learning compared with traditional lectures. It was claimed that the factor of success is not the video as such, but the *group interaction*.

The TVI-method has been extended into a TMI-method, *Tutored Media Instruction*, making use of other instructional media such as computer aided instruction and multimedia. The TMI-model provides a very flexible framework for the use of instructional media. It can be adapted towards regional, institutional, content-specific, and above all it can be adopted to learner-specific needs, individual learning experiences and learning styles, previous knowledge, and different cultural backgrounds.

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Visual literacy in message design

Abstract. *The theme for this 33rd Annual Conference of the International Visual Literacy Association in Eskilstuna, Sweden, is "Visual Literacy in Message Design". Both visual literacy and message design are broad concepts, each with a long history. Researchers with different kinds of backgrounds have shown an interest in visual literacy. This is also true for message design, which can be divided in several categories. Various areas of design have different objectives and the information materials reach out to different groups of receivers. Visual literacy and the use of images is important in message design. At the same time message design is important in the study of visual literacy. The concepts of visual literacy and message design partly overlap one another.*

Visual literacy

Although the term "visual literacy" may be modern, it is not at all a new idea or a new concept. Discussions about the use of images and pictures have a long history. Already ancient philosophers used images for visual communication. In anatomy and medicine, Aristotle employed anatomical illustrations. In mathematics, Phythagoras, Socrates, and Plato used visual images to teach geometry. Jesus Christ and other religious educators and prophets helped their listeners create inner images by means of different metaphors. In Mesoamerica, the old cultures and civilizations used advanced pictorial messages, especially in their temple cities. Velders (1999) concluded that (p. 10): "The history of visual communication goes back to the cave paintings 30,000 years ago, the description of it only 2,500. ... visual literacy is 2,500 years old (as a skill) and 30 years young (as a term)."

Definitions

The International Visual Literacy Association, IVLA, was established as a non-profit association incorporated in the State of New York in 1968 to provide a multi-disciplinary forum for the exploration, presentation, and discussion of all aspects of visual communication and their various applications through visual images, visual literacy, and literacy in general. Since then IVLA members and others have formulated a number of definitions, descriptions and discus-

sions of visual literacy. References to selected examples are shown in Table 1. Many definitions or explanations of visual literacy, visualization and understanding of pictures have been considered important at the time.

Table 1. Visual literacy definitions

Year	*Authors*
1969	Arnheim; Debes
1970	Debes
1971	Chaplin; Paivio
1972	Fransecky and Debes
1973	Dondis
1974	Maccoby and Jacklin
1975	Jonassen and Fork; Spitzer and McNerny
1976	Cochran; Fork and Jonassen
1977	Lucas
1978	Ausburn and Ausburn; Levie; Williams; Zimmer and Zimmer
1979	Foster
1980	Griffin and Butt; Hortin
1981	Cook; Szabo, Dwyer and DeMelo
1982	Braden and Hortin; Esdale and Robinson; Heinich, Molenda and Russell; Hortin
1983	Earl; Lampe
1984	Griffin and Whiteside; Hortin
1985	Reynolds Myers; Whiteside
1986	Arnheim; Considine; Sinatra
1987	Braden; Curtiss; Lacy; Schiller
1988	Hanson; Hanson, Silver and Strong; Ragan
1989	Hansen; Kissick and Grob; Pettersson
1990	Clark-Baca; Clark-Baca and Braden; Schallert–Lawrie
1991	Braden and Clark-Baca; Hugo and Skibbe; Leahy; Miller
1992	Sutton
1993	Messaris
1994	Bopry; Messaris; Moore and Dwyer; Seels
1995	Schiffman; Brouwer
1996	Avgerinou and Ericson; deLange
1997	Stewig
1998	Allmendinger
1999	Avgerinou and Ericson; Paquin
2000	Avgerinou

A recent definition was provided by Avgerinou (2000). Avgerinou used the following *operational definition* of visual literacy (p. 26): "In the context of human, intentional visual communication, *visual literacy* refers to a group of largely acquired abilities, i.e. the abilities to understand (read), and use (write) images, as well as to think and learn in terms of images."

Over time, definitions have varied from very narrow to very broad explanations of greater or lesser complexity. In accordance with Avgerinou and Ericson (1999, p. 22) there seem to be as many definitions as there are visual literacists. There has been, and there still are considerable disagreements concerning a common definition of visual literacy. Avgerinou and Ericson (1997) concluded that many have tried to define the concept of visual literacy, but so far they had found no consensus. It is clear that it is difficult to describe verbally a concept that is primarily nonverbal. A number of researchers have practically rejected the whole concept of "visual literacy" and they search for something else.

Interdisciplinary

Visual literacy is really a broad and interdisciplinary concept including biological perspectives, communication perspectives, presentational perspectives, religious perspectives, social perspectives, technological perspectives, visual language perspectives, and bits and pieces from several other "established fields" of research. Many researchers from different disciplines have explained their views and interpretations and written about visual literacy from their various perspectives. Selected references to such papers are shown in Table 2.

Table 2. Visual literacy perspectives

Fields	*Authors*
advertising	Griffin and Whiteside 1984; Besser 1987; Velders 1996
aesthetics	Bakony 1983; Metallinos 1991; Seward Barry 1994; Velders 1996
adult education	Kissick and Grob 1989; Velders 1995
anatomy	Metallinos 1994
art	Arnheim 1969; Gonsalves 1983; Arnheim 1986; Curtiss 1987; Hortin 1994; Seward Barry 1994; Velders 1996
art education	Dondis 1973
art history	Garoian 1989; Velders 1995, 1999
audiovisual media	Cochran 1976
biology	Lord 1985; Wandersee 1992
brain research	Lampe 1983; Sinatra 1986

Fields	*Authors*
business presentations	Griffin and Butt 1980; Griffin and Whiteside 1984; Griffin 1994
cable television	Johnson 1988
chemistry	Talley 1973
child development	Ausburn and Ausburn 1978
cognitive development	Reynolds Myers 1985
cognitive style	Lampe 1983; Hanson, Silver and Strong 1988
communication	Curtiss 1987; Kennett, and Bradford 1989; Schallert–Lawrie 1990; Wisely 1994
computer science	Whiteside 1983; Griffin and Whiteside 1984; Ragan 1988
computer literacy	Considine and Haley 1992
creativity	Couch, Caropreso and Miller 1994
curriculum	Martinello 1985; Miller 1987; Ragan 1988; Robinson 1991
education	Dondis 1973; Muffoletto 1983; Muffoletto 1984; Evans, Watson and Willows 1987; Miller 1987; Bertoline, Burton and Wiley 1992
educational communication	Levie 1978
engineering	Earl 1983; Miller and Bertoline 1991; Miller 1992
English	Foster 1979; Barry and Leaver 1989;
ethics	Limburg 1988
film	Foster 1979; Bakony 1983; Miller 1989
graphic design	Hardin 1983; Bennett 1989; Pettersson 1989; Braden 1994
history	Schiller 1987; Leahy 1991
iconology	Velders 1995
illustration	Levie and Lentz 1982; Thompson 1994
image design	Pettersson 1989; Thompson 1994
infology	Pettersson 1989
information literacy	Sutton 1992
information technology	Braden 1987
instruction	Levie 1978; Bennett 1989; Fredette 1994
instructional design	Levie 1978; Heinich, Molenda and Russel 1982; Braden 1989
journalism	Barnhurst and Whitney 1991
language	Greenlaw 1976; Griffin and Whiteside 1984; Wilson 1988
learning	Dwyer 1978; Colwell, Mangano and Hortin 1983; Lampe 1983; Hanson, Silver and Strong 1988; Curtiss 1990; Stern and Robinson 1994; Seward Barry 1997
library science	Good 1987

Fields	*Authors*
literacy	Wilson 1988
mathematics	Maccoby and Jacklin (1974)
media	Cochran 1976; Whiteside 1985, Lloyd-Kolkin and Tyner 1990
media education	Velders 1995
media literacy	Sutton 1992
neurophysiology	Metallinos 1994
object language	Moore 1994
perception	Haber and Myers 1982; Hanson, Silver and Strong 1988; Sutton 1990; Metallinos 1991; Messaris 1993; Stern and Robinson 1994; Seward Barry 1994; Seward Barry 1997
philosophy	Debes 1970; Leahy 1991; Hortin 1994
photography	Muffoletto 1982; Oudejans 1988; Sutton 1992
phototherapy	Krauss 1984; Weiser 1984
physiology	Metallinos 1994
psychology	Hanson, Silver and Strong 1988; Moore 1988; Hortin 1994
reading	Levin and Lesgold 1978; Sinatra 1986; Bennett 1989
semiology/ semiotics	Muffoletto 1994; Velders 1995
teacher education	Muffoletto 1983
teaching	Barry and Leaver 1989; Garoian 1989; Rezabek 1990; Robinson 1992
television	Foster 1979; Becker 1987; Johnson 1988; Robinson 1988; Barry and Leaver 1989, Miller 1989
test design	Avgerinou and Ericson 1997; Avgerinou 2000
text design	Bennett 1989
thinking	McKim 1980a 1980b; Braden and Hortin 1982
video	Williams 1988; Hobbs 1989
visual art	Arnheim 1969, 1986; Gonsalves 1983; Curtiss 1987; Hortin 1994; Seward Barry 1994; Velders 1996
visual cognition	Sinatra 1986; Miller and Burton 1994; Seward Barry 1997
visual design	Thompson 1994
visual communication	Dondis 1973; Seels 1994; Sewell 1994
visual language	Moore and Dwyer 1994; Braden 1994; Seward Barry 1994
visual learning	Dwyer 1978; Moore and Dwyer 1994; Nelson Knupfer 1994; Seels 1994
visual intelligence	Seward Barry 1997
visual thinking	Arnheim 1969; Seels 1994
writing	Wilson 1988

There are of course more examples to be found. A large number of papers have been presented at the Annual Conferences of the International Visual Literacy Association and many have been published in our "Selected Readings" and in our "Journal of Visual Literacy". Despite all our combined efforts during the past 33 years visual literacy has not been able to attract enough interest from society and enough interest from those responsible for the school curricula around the world. An important reason for this may be a genearl lack of focus. In my view we need to consider *combined verbo-visual messages,* not only text and not only visuals when we study communication and communication related issues. This is where *message design*, and its different subareas, may play an important role for visual literacists.

Message design

In the *The new Shorter Oxford English Dictionary on Historical Principles* (Brown, 1993) the term *message* is defined (p. 1752) as: "brief communication transmitted through a messenger or other agency; an oral, written, or recorded communication sent from one person or a group to another." In the same book the general meaning of the word *design* is defined (p. 645) as: "plan and execute (a structure, work of art, etc.); fashion, shape; make a preliminary sketch for (a work of art, etc.); make drawings and plans for the construction of production of (a building, machine, garment, etc.)". In my view *message design* comprises analysis, planning, presentation and understanding of a message—its content, language and form. Regardless of the selected medium, a well designed message will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. Many information and communication theorists have devised models to explain the way the communication process or processes operates.

As early as 1948 Lasswell put it this way: communication are *who* says *what* to *whom* via which *channel* and to what *effect*. Then Shannon and Weaver (1949) proposed a mathematical communications model, which illustrates the way a signal is passed on from a sender to a receiver. The model was originally developed for studies of technical systems. However, this model has been used frequently for discussions about human communication (Figure 1).

Figure 1. The classical view is that communication takes place when a sender conveys a message to a receiver. Focus is on the sender and on the receiver.

Traditional communication models are directional and process-oriented. However, Hall (1980) developed the encoding – decoding model. Here the sender is an *encoder* constructing "meaningful" texts, such as a television program or an information material. The receiver is a *decoder,* and is assumed to accept, negotiate or oppose the intended meaning. Hall emphasized the paradigm shift to earlier traditions.

During the 1990s there has been a change in reception analysis from a focus on interpretation and decoding to a greater concern with practice and use (Hagen, 1998). This development has been described as a change from decoding to viewing context (Morley, 1992). We can see the sender as an "information provider" (Figure 2).

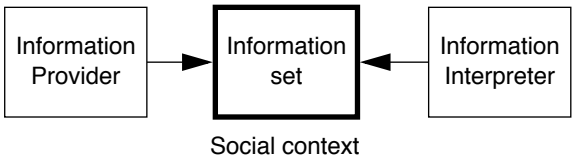

Figure 2. An information set model. An information provider makes one or more information sets available for people who need the information, information interpreters. Here the focus is on the information set.

The designer makes certain information available for different groups of people. An information set may be a book, a paper, a poster, a symbol on a signpost, a web-page, and many other products. In each case the sender or the designer may have clear intentions and objectives. However, it is up to the individual "information interpreter" to actively conceive or misconceive the information, to use or not use it, to use or misuse it. This view is specially valid for information sets that people make available to an unknown audience, e.g. on the Internet and the WWW. Here it is usually not possible to know much about the people who search for, and use the information.

Message design is an interdisciplinary field of knowledge. It encompasses influences and facts from more than fifty established disciplines and areas of research. The main areas of research may be divided into the following six groups with "base disciplines". However, also other groupings are possible.

1. *Language disciplines* such as drama, graphic design, linguistics, rhetoric, semiology/semiotics, verbal languages, visual languages and visual literacy. (From a message design perspective the language aspects of graphic design are more important than the art aspects.)
2. *Art and aesthetic disciplines* such as aesthetics, computer graphics, film and cinema, iconography, iconology, illustration, and photography.

3. *Information disciplines* such as computer science, information processing, and library and information science.
4. *Communication disciplines* such as communication theory, education technology, information design, information technology, information theory, instructional design, instructional message design, instructional technology, journalism, media studies, persuasive design, planned communication, television and video.
5. *Behavioural and cognitive disciplines* such as cognitive science, didactics, information ergonomics, pedagogy, psychology, sociology and their subareas. The study of attention, perception, cognitive skills and memory are especially important. Some aspects deal with individuals, and some with the societies in which we live.
6. *Business and media production technology disciplines* such as business economics and management, information economics, information management, law, technologies for production and distribution of different media.

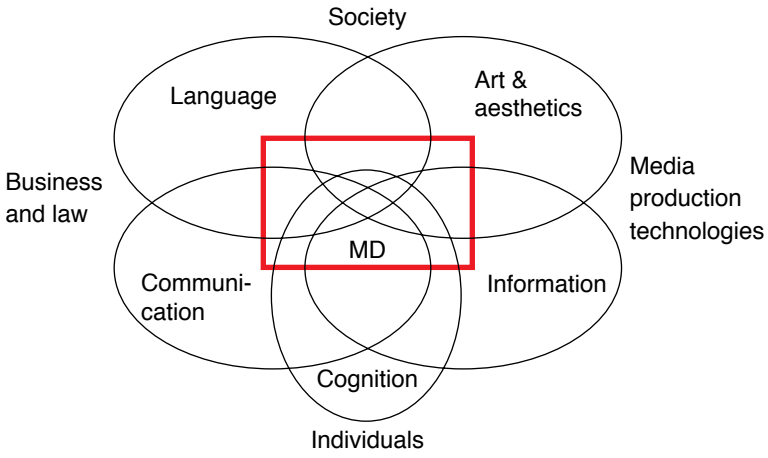

Figure 3. A model of message design, MD.

Please note that the ovals in the illustration above (Figure 3), and in the following illustrations (Figures 4, 6 and 7), representing the various groups of disciplines are not at all ment to be sharp and distinct. The borders between the areas are rather blurred, unclear, and indistinct. Furthermore, these models are not intended to show any *exact* relationships between the different groups of the base disciplines, rather subjective approximations.

The main components in message design are words, visuals and form. These components may be used in many different ways to produce, transmit and interpret messages of various kinds in different communication situations. Depend-

ing on the different objectives we can see different "message design fields" or "information set design disciplines", all are used for communication purposes.

Graphic design

Traditional *graphic design* has a history of hundreds of years. It is a kind of "all purpose-design" used in the production of various media. A generally accepted view is that graphic design may be described as the art and craft of bringing a functional, aesthetic, and organised structure to groups of diverse elements. These elements may be headings, texts, pictures, captions, and tables. Pettersson (1999) noted that *graphic design* includes typography, layout, visual graphic design, and parts of architecture and industrial design. In graphic design the main objective is to provide functional, aesthetic, and organised structure to all kinds of information sets. Here, the information interpreter might be seen as a "reader". Graphic design is used as an important "tool" in the other four groups of message design: mass design, persuasion design, information design, and instruction design.

Mass design

I use the term *mass design* as an umbrella term in order to bring related mass design areas together. This group could also be labelled "entertainment design". Mass design includes aspects from communication studies, mass-communication, media studies, photography, and journalism. Thus it is a very large field. Here the main intentions with the "messages" are to provide news, views, and entertainment to large audiences. The individual information interpreter might be seen as a "relaxer".

Persuasion design

I use the term *persuasion design* as an umbrella term in order to bring the related persuasive areas together. Persuasion design is interdisciplinary and it includes main aspects from planned communication, persuasive communication, advertising, and propaganda. Persuasion design comprises studies on carefully planned information activities, where the goals are related to some kind of change in the behaviour of the receivers. Receivers are typically asked to *do something*. Ads may ask people to vote, go to church, or stop smoking. Often the intention is to persuade them to buy a specific service, product or attitude. Bettinghaus and Cody (1987, p. 1) noted that *persuasion* is an important part of the daily life of every human being. What we eat, what we wear, whom we listen to, what music we prefer, what church we go to, and whom we will vote for in the next election are all issues that are affected by *persuasive communication*.

In fact, persuasion is used so frequently and is so pervasive in our daily lives that we often fail to recognize when we are using persuasive communication, as well as when we are exposed to it.

As a result of successful persuasion design the selected receivers will get new views, new opinions and emotions, reinforced attitudes, beliefs, a willingness to buy, and apprehensions or prejudices. As a minimal condition, to be labelled as persuasive, a communication situation must involve a conscious attempt by one individual to change the attitudes, beliefs, or behaviour of another individual or group of individuals through the transmission of some message (Bettinghaus and Cody, 1987, p. 3). The information interpreter might be seen as a "possible buyer", a "prospect".

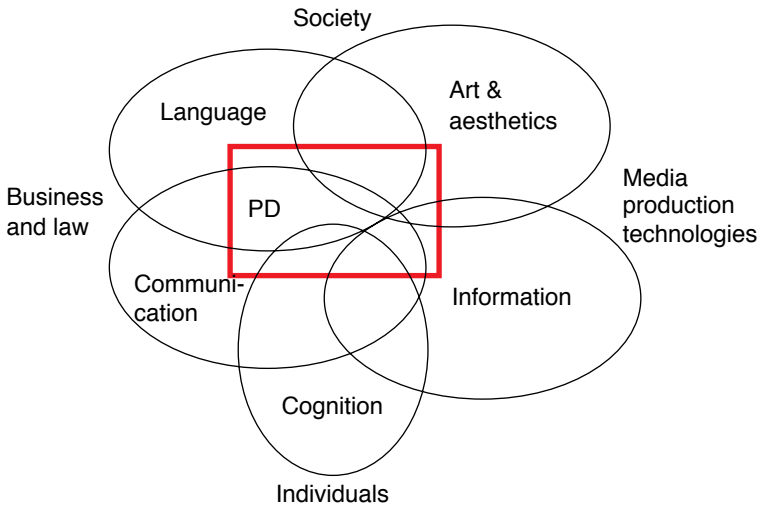

Figure 4. A model of persuasion design, PD.

Information design

I use the term *information design* as an umbrella term in order to bring related information areas together. In my view information design may be defined in the following way: "In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message—its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements." (Easterby and Zwaga 1984; Pettersson, 1998a, 1998b, 1988c, 1998d.)

Information design includes parts of technical illustration, scientific illustration, technical writing, technical communication, informative layout (Lidman 1966), lexi-visual layout (Lidman and Lund 1972), communication design

(Marsh 1983), visual interface design, visual literacy, and parts of information ergonomics, as well as design of graphical user interfaces (Figure 5).

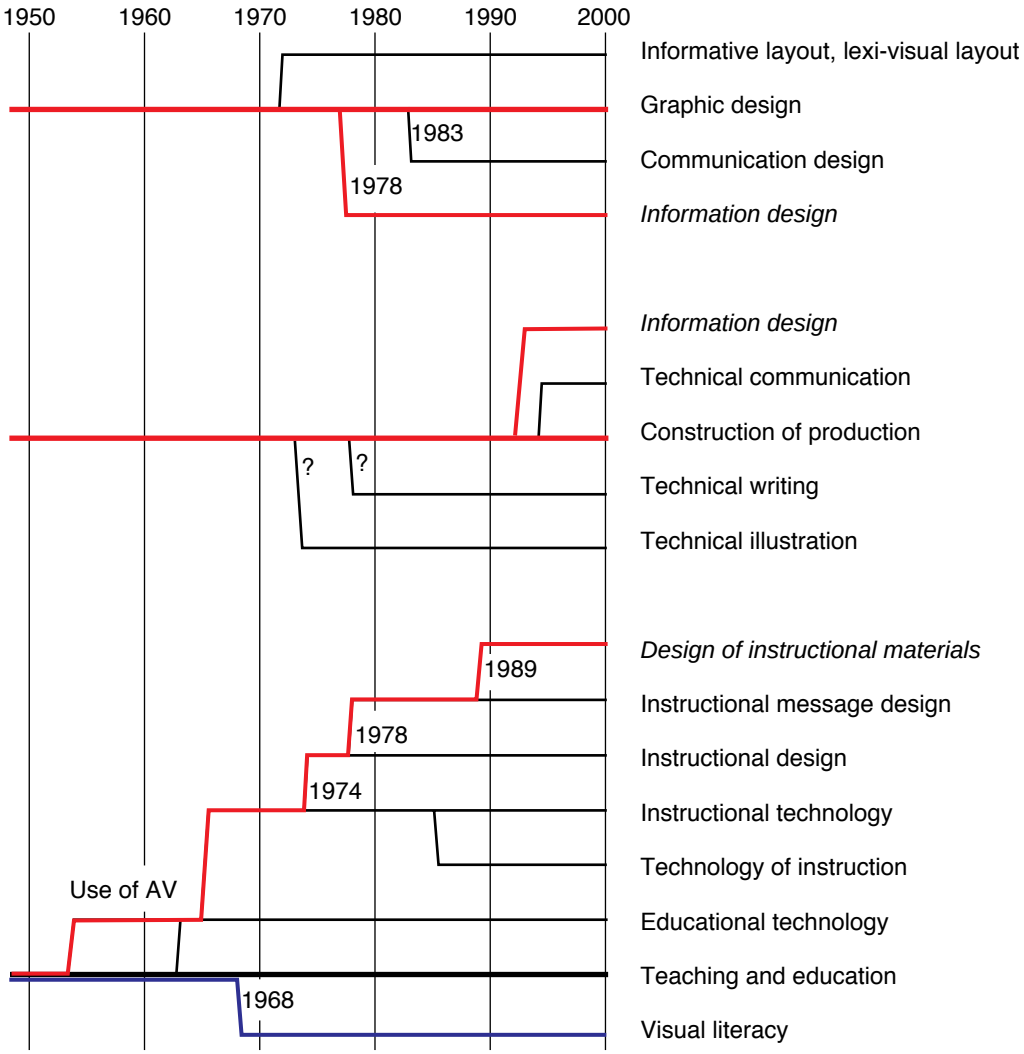

Figure 5. A view of the evolution of visual literacy and information design.

In information design the main objective is to provide information materials needed by the interpreter in order to perform specific tasks. The information interpreter might be seen as a "doer". The interpreter / s may develop new skills, understanding, and experience. A model of information design is presented in figure 6.

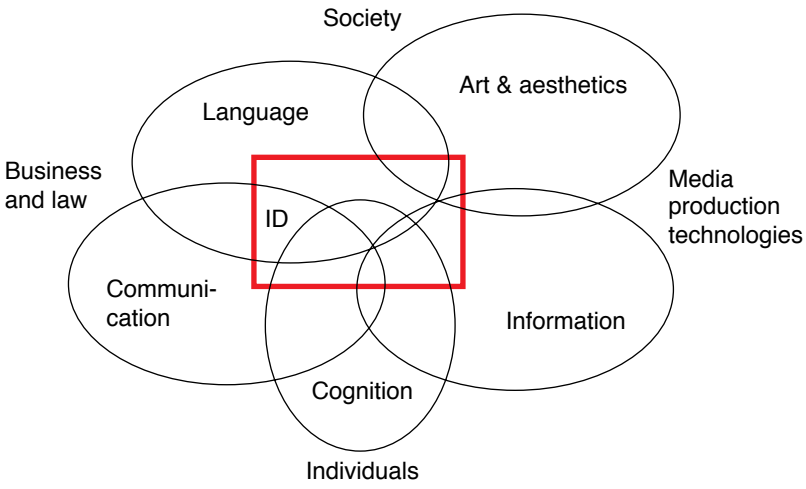

Figure 6. A model of information design, ID.

Instruction design

I use the term *instruction design* as an umbrella term in order to bring related instruction areas together. Instruction design can be seen as an evolving area of knowledge. It is interdisciplinary and includes main aspects from several areas dealing with *instruction* and *learning*, but from different perspectives, and with different emphasis. Within each area the various definitions and descriptions have changed over time, which is sometimes confusing (Pettersson, 1998a, 1998b, 1988c, 1998d).

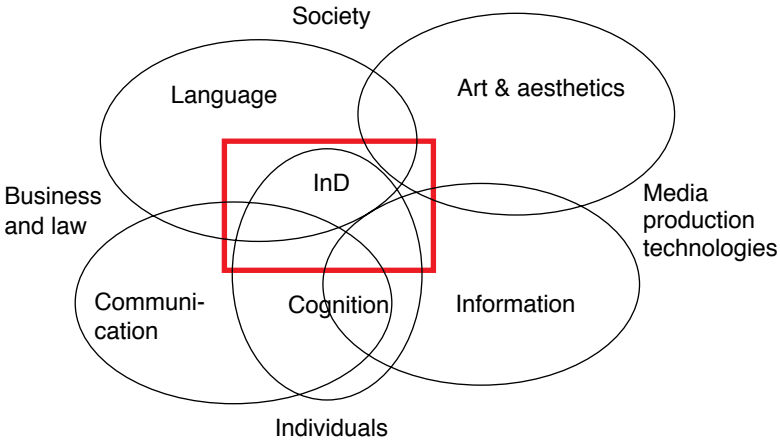

Figure 7. A model of instruction design, InD.

Instruction design (Figure 5) includes parts of audio-visual instruction (Saettler 1968), educational technology (Morgan 1970), instructional technology (Saettler 1968), visual literacy, technology of instruction (Glaser 1978), instructional design (Gagne and Briggs 1974), instructional message design (Fleming and Levie 1978), and design of instructional materials (Briggs and Wager 1989). There seems to be no major difference between these areas, and they are all closely related to information design. The various instructional areas are, however, more narrow than information design. The main intentions are to provide courses lessons and materials intended for learning. The interpreter/s may develop new understanding, experience, comprehension, knowledge, insight, and finally wisdom. We can note a paradigm shift from the old and traditional focus on teaching to a focus on learning.

Performance objectives

Several researchers have pointed out that it is important to define clear objectives in message design (Heinich, Molenda and Russell, 1982; Marsh, 1983; Fleming and Levie, 1993; and Wileman, 1993), as well as in information design (Mullet and Sano, 1995; and Pettersson, 1998c, 1998d).

A performance, and a change in behaviour, must be *observable*. Thus subjective objectives defined by verbs like *appreciate, assess, describe, discuss, evaluate, know, outline,* and *understand* should be avoided. A statement of design objectives should include the conditions under which the required performance is to be observed and measured, when such conditions are relevant. *Time* and *accuracy* are often meaningful dimensions in assessment of objectives.

When performance is qualitative rather than quantitative, the performance may be assessed by a group of experts. It should be noted that there is an increasing incidence of law suits being brought against manufacturers in the USA. These law suits claim damages as a result of accidents occurring, or products breaking because of poor quality in the language of instruction manuals (Helyar, 1992). The courts are demanding that technical manuals, brochures, information sheets, and labels be written in comprehensible language, and that descriptions and instructions *be readable and legible*. Everywhere, plaintiffs' counsels are searching frenetically for sections of text and parts of pictures that might be interpreted in conflicting ways. If a manufacturer's technical documentation is difficult to understand, the company can lose a lawsuit and then have to pay large sums of money.

In **graphic design** it may be an advantage to use verbs like *find, identify, read,* and *recognise.* These verbs all denote observable behaviour.

In **mass design** it may be an advantage to use verbs like *feel, laugh, look, read,* and *relax.* These verbs all denote observable behaviour.

In *persuasion design* it may be an advantage to use verbs like *appreciate, believe, buy, change (behaviour), desire, dread, fear, feel (relaxed), hate, and have (fun)* in the writing of persuasion design objectives. These verbs all denote observable behaviour.

In *information design* it may be an advantage to use verbs like *apply, arrange, assemble, build, change, code, complete, compose, conduct, construct, cut, demonstrate, develop, draw, explain, find, generate, get, identify, illustrate, install, label, locate, make, modify, name, operate, pack, paste, predict, prepare, produce, put, read, recognise, reconstruct, remove, revise, sort, specify, start, type, verify,* and *write* in the writing of information design objectives. These verbs all denote observable behaviour.

In *instruction design* it may be an advantage to use verbs like *apply, arrange, complete, compose, conduct, construct, define, demonstrate, explain, find, identify, illustrate, label, modify, name, predict, prepare, recognise, reconstruct, revise, specify, verify,* and *write* in the writing of instruction design objectives. These verbs all denote observable behaviour.

The objectives with information set design disciplines may be summarised in the following way:

- In *graphic design* the main intentions are to provide functional, aesthetic, and organised structure to all kinds of information sets. The interpreter/s may develop new views, relaxation, emotions, attention, understanding, and awareness.
- In *mass design* the main intentions are to provide news, views, and entertainment. The interpreter/s may develop views, relaxation, emotions, and awareness.
- In *persuasion design* the main intentions are to provide advertising or propaganda in order to persuade interpreters to buy a product or a service, or to change behaviour. The interpreter/s may develop new prejudices, apprehensions, willingness to buy, beliefs, reinforced attitudes, emotions, opinions, and views.
- In *information design* the main intentions are to provide information materials needed by the interpreter in order to perform a specific task. The interpreter/s may develop new skills, understanding, and experience.
- In *instruction design* the main intentions are to provide courses and learning materials needed by the interpreter in order to modify behaviour with respect to learning. The interpreter/s may develop new understanding, experience, comprehension, knowledge, insight, and finally wisdom.

Conclusions

Both visual *literacy* and *message design* are broad concepts, each with a long history. Researchers with different kinds of backgrounds have shown an interest in visual literacy. This is also true for message design, which can be divided in several categories. Various areas of design have different objectives and the information materials reach out to different groups of receivers.

It can be concluded that visual literacy and the use of images is important in message design. It can also be concluded that message design is important in visual literacy. The concepts visual literacy and message design partly overlap one another (Figure 8). In many situations it is, however, not enough to study visuals only. We need to consider and study combined verbo-visual messages, not only text and not only visuals when we study communication and communication situations.

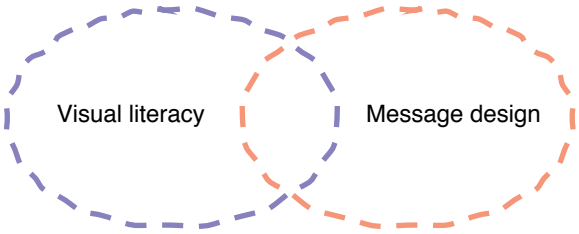

Figure 8. Visual literacy and message design are broad concepts.

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Image functions

Abstract. *This paper presents functions of pictures used in printed media, evaluations of intentions of the sender's, evaluations of the purposes for using visuals in teaching, and examples of the purposes for using visuals in information materials in printed media. The paper includes a discussion about selection and use of pictures with emphasis of the use of pictures in information design.*

Traditional image functions

Visuals are perceived much more rapidly and readily than text (Fleming and Levie, 1978, 1993; Sinatra, 1986). Lester (1995:73) noted that: "Visual messages are a powerful form of communication because they stimulate both intellectual and emotional responses — they make us think as well as feel." Many papers have suggested various roles, functions, objectives and purposes for the use of illustrations—often without a great deal of evidence to support the suggestions.

Still pictures

According to literature in the areas of instructional message design, visual literacy, and visual communication visuals may be used in order to:

add concreteness to prose (Levin, Anglin & Carney, 1987)

adopt a new attitude (Heinich, Molenda & Russell, 1982)

adorn something (Selander, 1988)

advance organizing of text comprehension (Bernard, Petersen & Ally, 1981)

aid credibility (Fleming & Levie, 1978)

anchor an image in memory (Moriarty, 1991)

appeal to the eye (Duchastel, 1983; Levin, 1981)

assist in concept development (Fredette, 1994)

associate the product with certain symbols and lifestyles (Moriarty, 1991)

attract attention to a given material or a given subject (Duchastel, 1978; Duchastel & Waller, 1979; Holliday, 1980; Heinich et al., 1982; Levie & Lentz, 1982; Evans, Watson & Willows, 1987; Levin et al., 1987; Pettersson, 1993; Keller

& Burkman, 1993; Wileman, 1993; Lester, 1995)

be effective (Keller & Burkman, 1993)

beautify something (Selander, 1988)

break up longer blocks of text and make the pages more appealing (Duchastel, 1978)

bring inaccessible processes such as historical events or microscopic changes to the audience (Moriarty, 1991)

bring into the classroom inaccessible processes, events, situations, materials, and phase changes in either space or time (Dwyer, 1978)

build new experience (Fredette, 1994)

carry the proof of a presentation (Griffin, 1994)

change a viewer's attitude (Lester, 1995)

clarify opinions (Fredette, 1994)

clarify oral and printed communication (Dwyer, 1978)

clarify passages in a text (Levin et al., 1987)

clarify pieces of an abstract, language-based concept (Wileman, 1993)

communicate a message in an efficient way (Wileman, 1993)

compare (Fredette, 1994)

compare one image content with another (Hunter, Crismore & Pearson, 1987)

compensate poor readers (Duchastel, 1978)

contrast (Fredette, 1994)

contrast one image content with another (Hunter, Crismore & Pearson, 1987)

contribute to curiosity (Keller & Burkman, 1993)

convey an idea (Lester, 1995)

convey information to the reader or viewer (Dondis, 1973; Pettersson, 1989)

convince someone using factual information, persuasion (Lester, 1995)

correct misconceptions (Fredette, 1994)

create believability through realism (Moriarty, 1991)

create interest in a given material or in a given subject (Duchastel, 1978; Duchastel & Waller, 1979; Holliday, 1980; Levie & Lentz, 1982; Levin et al., 1987; Pettersson, 1993)

deceive learners; aesthetically pleasing visuals may deceive learners about their instructional value (Dwyer, 1972)

decorate something (Dondis, 1973; Levin et al., 1987; Selander, 1988; Fredette, 1994)

demonstrate product features (Moriarty, 1991)

depict elements of the instructional content (Levin et al., 1987)

depict reality (Pettersson, 1989)

depict situations and settings (Moriarty, 1991)

designate spatial orientation (Pettersson, 1989)

develop appreciation (Heinich et al., 1982)

discriminate among facts (Heinich et al., 1982)

display information (Fredette, 1994)

dupe an unsuspecting public through misleading or false information, propaganda (Lester, 1995)

elaborate the text (Hunter et al., 1987)

embellish the text (Hunter et al., 1987)

emphasize aural and printed instruction (Dwyer, 1978)

encourage the expression and clarification of opinions (Fredette, 1994)

enhance enjoyment (Levie & Lentz, 1982)

enhance the reality of a material for the reader (Smith & Smith, 1966)

enrich reading (Dale, 1969)

establish a mood (Moriarty, 1991)

establish a product personality (Moriarty, 1991)

evaluate learning (Fredette, 1994)

exemplify something (Melin, 1986a; Pettersson, 1989)

explain difficult phenomena (Winn, 1993)

explain things (Pettersson, 1989)

express opinions (Fredette, 1994)

express the artist's feelings (Dondis, 1973)

extend curiosity (Peeck, 1987)

facilitate cognitive processes (Levin et al., 1987)

facilitate discrimination and identification of relevant cues (Dwyer, 1978)

facilitate learner acquisition of information (Dwyer, 1978)

facilitate learning from a text by enhancing comprehension and memory (Levin & Lesgold, 1978; Duchastel, 1981; Levie & Lentz, 1982; Levin et al., 1987)

facilitate reading, make it easier for poor readers to comprehend, learn, and recall things they read in a text (Duchastel, 1978)

facilitate retention (Dwyer, 1978; Winn, 1993)

facilitate understanding (Pettersson, 1989)

flatter the audience (Zakia, 1985)

focus on a particular aspect (Wileman, 1993)

foster generalizations of responses to new situations (Dwyer, 1978)

gain or *get attention* (Duchastel, 1978; Duchastel & Waller, 1979; Holliday, 1980;

Levie & Lentz, 1982; Evans et al., 1987; Levin et al., 1987; Moriarty, 1991; Keller & Burkman, 1993; Pettersson, 1993; Wileman, 1993; Lester, 1995)

give precise descriptions and information (Zimmer & Zimmer, 1978)

glorify an individual or a group (Dondis, 1973)

guide learners to think carefully and make conclusions (Dwyer, 1978)

help learners remember what they read (Levie & Lentz, 1982)

help learners understand what they read (Levie & Lentz, 1982)

help people remember (Wileman, 1993)

hold attention (Levin et al., 1987)

identify something (Dwyer, 1972; Dondis, 1973; Heinich et al., 1982)

illustrate appearance (Pettersson, 1989)

illustrate key points, and relationships (Massoumian, 1989)

illustrate oral and printed communication (Dwyer, 1978)

illustrate selected main points (Fredette, 1994)

illustrate something (Melin, 1986a)

impact emotions (Vernon, 1953)

increase learner interest, motivation, curiosity, and concentration (Dwyer, 1978)

increase learning retention (Wileman, 1993)

increase reliability of communication (Dwyer, 1978)

induce perspective into a text (Peeck & Goud, 1985)

influence viewers (Lester, 1995)

inform, as a main information source (Fredette, 1994)

instruct (Levie & Lentz, 1982; Pettersson, 1989)

integrate facts, skills, and judgements (Dwyer, 1978)

interpret and explain difficult phenomena (Levin et al., 1987; Winn, 1993)

introduce new information (Dwyer, 1978; Griffin, 1994)

isolate specific instructional characteristics (Dwyer, 1978)

label facts (Levie & Lentz, 1982)

link information, and maintain the continuity of a presentation (Griffin, 1994)

maintain interest by presenting a mesmerizing image or sequence (Moriarty, 1991)

maintain learner attention (Keller & Burkman, 1993)

maintain the continuity of a presentation (Griffin, 1994)

make learning more precise and complete (Dwyer, 1978)

make reading more concrete (Travers & Alvarado, 1970; Duchastel, 1978)

make reading more enjoyable (Duchastel & Waller, 1979)

memorialize an individual or a group (Dondis, 1973)

memorize facts (Heinich et al., 1982)

modify behaviour (Lester, 1995)

motivate a person to pick up, browse through, and read a text (Duchastel, 1978, 1983)

motivate students (Heinich et al., 1982; Evans et al., 1987; Winn, 1993; Fredette, 1994)

organize information, temporal and spatial relationships (Levin et al., 1987)

organize new information (Dwyer, 1978)

overcome time and distance (Dwyer, 1978; Moriarty, 1991)

perpetuate ideas that words alone cannot (Lester, 1995)

persuade ideas that words alone cannot (Lester, 1995)

persuade people to buy a particular product or think a specific way (Lester, 1995)

persuade someone (Heinich et al., 1982; Lester, 1995)

persuade the audience (Zakia, 1985; O'Keefe, 1990)

present a variety of vantage points, locations of parts, relationships (Dwyer, 1978)

present abstract and difficult material (Levin et al., 1987)

present more information than text in a given amount of space (Wileman, 1993)

present new information (Dwyer, 1978)

present outlines, lists, and complex materials (Massoumian, 1989)

preserve people, places, and objects (Dondis, 1973)

prevent misconceptions (Fredette, 1994)

provide authority, information, overview, and variation (Pettersson, 1989)

provide background information (Fredette, 1994)

provide extra linguistic information (Levie & Lentz, 1982)

provide greater flexibility and variety in the organization of instruction (Dwyer, 1978)

provide instructional feedback (Dwyer, 1978)

provide organization and a framework for a text (Levin et al., 1987)

raise questions (Dwyer, 1978)

record people, places, and objects (Dondis, 1973)

reinforce aural and printed instruction (Dwyer, 1978)

reinforce memory (Winn, 1993)

reinforce oral and printed communication (Dwyer, 1978)

reinforce the creative concept (Moriarty, 1991)

reinforce the text (Hunter et al., 1987)
replicate people, places, and objects (Dondis, 1973)
represent instructional content (Levin et al., 1987; Winn, 1993)
respond to need (Dondis, 1973)
scare the audience (Zakia, 1985)
seduce the audience (Zakia, 1985)
serve as advance organizers of information (Wileman, 1993)
shame the audience (Zakia, 1985)
sharpen powers of observation (Dwyer, 1978)
show spatial relationships (Zimmer & Zimmer, 1978)
show steps in a process (Levin et al., 1987)
show time and magnitude relationships (Pettersson, 1989)
simplify complex concepts (Wileman, 1993)
solve problems (Fredette, 1994)
span linguistic barriers (Dwyer, 1978)
stimulate discussion (Dwyer, 1978)
stimulate incidental learning (Fredette, 1994)
stimulate interest (Keller & Burkman, 1993)
substitute words (Levie & Lentz, 1982)
sum up information for retention and recall (Massoumian, 1989)
summarize important parts of a text (Hunter et al., 1987)
summarize the important points in a lesson (Dwyer, 1978)
supplement verbal information through elaboration (Fredette, 1994)
support statements made by linking visuals in a presentation (Griffin, 1994)
sustain statements made by linking visuals in a presentation (Griffin, 1994)
tease the audience (Zakia, 1985)
transfer culture to immigrants when employed in teaching aids (Aronsson, 1983)
transform content (Levin et al., 1987)
verify research (Fredette, 1994)
visualize instruction (Dwyer, 1978)
wrap up information in a presentation (Griffin, 1994)

The above list contains 169 opinions about image functions. More than one hundred different explanatory verbs are used to express these opinions. According to researchers in the areas of instructional message design, visual literacy, and visual communication the most common opinions on functions of visuals concern *attention:* attract, gain, get, hold and maintain attention are mentioned.

Other common explanatory verbs are: *facilitate, provide, persuade, create* (an interest in), *illustrate, clarify, motivate, present,* and *reinforce* information (to someone). As would be expected most of these purposes can be looked upon as clearly pedagogical or cognitive, in contrast to pictures used for entertainment, decoration, advertising or marketing.

Moving pictures and multi-media

Moving pictures can be *affective* and provide readers with entertainment and reinforce an experience both positively and negatively. They can *trigger associations* and *influence emotions* and attitudes, especially in movies and TV (Zakia, 1985). In advertising and television, pictures may carry *subliminal messages*. Ads for liquor or cigarettes, for example, sometimes use sexual symbols (Zakia, 1985). Leshin, Pollock, and Reigeluth (1992) noted the *attention-getting* capability of several visual devices. They mentioned zoom lens movement to emphasize important details. Other devices are split screens, shading and contrast, voice-over narration, text, and graphics. Leshin et al. (op. cit.) suggested that visual images can *facilitate* comprehension and retention of information through organizational, structural, and mne-monic (assisting memory) functions. Rowntree (1990) identified *motion* as a valuable characteristic of video.The author suggested the following video applications in which movement is an important attribute:

- To *demonstrate* the operation of tools or equipment.
- To *demonstrate* skills that learners are expected to emulate.
- To *conduct* experiments in which the processes must be observed.
- To *present* a dramatic or musical performance in which it is necessary for learners to see as well as hear the performers.
- To *analyze* change over time using animation, slow motion, or time lapse photography.
- To *reveal* the spatial, three-dimensional qualities of an object or structure.
- To *transport* learners into situations that could not otherwise be experienced
- To *present* primary source material for analysis, such as archival film of historical events or videotapes of naturally occurring situations.

Interpretation of intended image functions

In an attempt to study the intended functions or purposes of visuals two inquiry studies were performed with students at Stockholm University (study 1 and 2), one with various teachers in Sweden (study 3), one with teachers in five countries (study 4), and one study with Information Design students at Mälardalen University in Eskilstuna (study 5). As seen from Table 1 a total of 449 subjects took part in these five inquiries.Subjects mentioned a grand total of 827 image purposes. However, many of these are the same, or close. The exact number of different intended image functions has not been calculated.

Table 1. Image function studies.

Study	*Subjects*	*Total number of functions*	*Number of different functions*
1	180	238	63
2	82	391	147
3	40	84	43
4	101	110	66
5	46	179	83

Evaluating the presumed intentions of the senders

From 1986–1991, 180 students at Stockholm University were asked to make an attempt at evaluating the senders' "presumed intention or intentions" for visuals used in printed media (Pettersson, 1993). The 238 visuals collected for analysis and discussion in class were mainly published in newspapers, magazines, and brochures.

It was obvious that students saw visuals as performing a great number of different functions, no less than 63 different presumed functions were mentioned by the students. In many instances (51%), students felt that the sender's intention was to *induce* receivers to take a stand *for* some person or some issue. This obviously applied to visuals in advertising but also concerned visuals in editorial text to some extent. In this category the top ranking functions were: *sell* products, *sell* a life style, *sell* services, *convey* or *create* associations, and *convince* viewers about something. In some instances (30%), students felt that the senders were attempting to *convey objective information* about something. Here the top ranking functions were: *convey* factual information, *illustrate* factual circumstances, *document*, and *instruct*.

In a few instances, (11%), students felt that the sender's intention was to *induce* receivers to take an active stand *against* some person or some issue, and

in a few instanc-es, students felt that senders were attempting to *provide entertainment* (5%), or that visuals were used as adornment or *decoration* (3%). The functions arouse interest, create needs, document, sell, and supply information were not mentioned in the literature reviewed above.

Evaluating the presumed purposes for using visuals in teaching

From 1990–1991, 82 students at Stockholm University were asked to exemplify their teachers' "presumed purposes" for using visuals of different kinds in their teaching. The students gave a total of 391 presumed purposes (147 different). Some students provided one or two purposes, others gave more examples. Some of the purposes are fairly common, while other purposes are very specific. Several purposes are the same, some are synonyms or closely related to each other. After grouping and ranking it is clear that the most outstanding purposes are to *show* (77), and to *explain* (44). Other common purposes are to *visualize* (25), *illustrate* (24), *clarify* (23), *inform* (21), *summarize* (21), *convey* (17), *learn* and *remember* (17), *mediate* (17), *elucidate* (16), *present* (15), and *give* perceptions (13). Less common purposes are instruct (11), describe (10), entertain (10), complete (9), facilitate reading (9), inspire (8), make concrete (8), document (6), exemplify (5), compare (5), and "other" (10). The functions complete, describe, document, elucidate, inspire, and mediate were not mentioned in the literature reviewed above.

Evaluating the purposes for using visuals in teaching

In one assignment 40 teachers at junior high schools in Sweden revealed their purposes for which pictures were used in their classrooms in 1990. These teachers provided a total of 84 purposes (43 different). To a large extent we find these "teacher purposes" also in the material provided by the students above. The teachers only mentioned cognitive and pedagogical uses. The most common purposes were to *explain* (20), *show* (19), and *present* (8). Several additional purposes were also mentioned. Some of these were not mentioned in the literature reviewed above: context, deepening, describe, elucidate the evolution, give a background, give a break, give a perspective, inspire to writing stories, minimize abstractions, and one picture says more than a thousand words.

Pettersson et al. (1991) focused the interest on the teachers and their actual use of media and pictures in their teaching of geography in secondary schools in five countries: Australia, Greece, Japan, Sweden, and the USA. 101 teachers provided 110 purposes for using pictures in the teaching of geography. There were no less than 66 different purposes. Results from this study confirmed the above studies. Visuals are used for many different and individual purposes.

The most commonly cited purposes were: for factual realization to get realistic understanding and knowledge (13), to attract interest of students (9), and to make images of the area (9).

Evaluating the purposes for using visuals in information materials

In a fifth inquiry (1998) Information Design students at Mälardalen University in Eskilstuna were asked to provide one to five examples of the purposes for using visuals in information materials in printed media. 46 students answered the inquiry with a total of 179 purposes (83 different). Some of the purposes are fairly common, while other purposes are very specific. Several purposes are the same, some are synonyms or closely related to each other.

Among the students' opinions about the purposes with visuals in information materials we find most of the purposes mentioned in the literature, but also other purposes. The most outstanding purposes are to *visualize* (33), *clarify* (28), *inform* (22), *attract attention* (20), *facilitate reading* (19), *explain* (17), and *convey information* (9).

Discussion

Pictures and images are often used in teaching and learning, and in information materials. It is obvious that visuals may have many different functions.

Teaching and learning

According to Fredette (1994:243) a 1978 survey of 72 sixth through ninth grade teachers in Australia revealed the purposes for which photographs were used in their classrooms. The main reasons were for *display* only, to *add decoration*, to *illustrate* selected main points, for *motivation*, and to *stimulate* incidental learning. According to the body of research cited in the first section of this paper the main functions of still pictures are to: *attract, gain, get, hold* and *maintain attention*, to *facilitate, persuade, provide, create* (an interest in), *illustrate, clarify, motivate, present*, and *reinforce*. The inquiries with students and teachers presented in the previous section showed that there may be many purposes for the use of visuals in printed media. Most of the purposes can be looked upon as clearly pedagogical or cognitive, in contrast to pictures used for entertainment, decoration, advertising or marketing. According to students the most common purposes of pictures in the school environment were to: *show, explain, visualize, illustrate, clarify, inform, summarize, convey, mediate, elucidate, present, give, instruct* and *describe*. The teachers noted: *explain, show, factual realization, attract interest,*

present, and make images. Evans, Watson and Willows (1987) noted that the attention-getting and motivational aspects of illustrations in textbooks seemed to predominate among the teachers in Canada. This was however, not the case among the teachers in the sample from Sweden. The Canadian teachers made very few direct references to illustrations in the classroom, and they provided little guidance in the educational functions that illustrations are thought to serve. Gustafsson (1980a, 1980b) found that this also was the case in Sweden.

Experiments with pupils in junior schools (Eklund, 1990), in intermediate schools and in junior high schools (Backman, Berg, and Sigurdson, 1988) showed that pupils in Sweden had a very low "pictorial capability". At all levels pupils have large difficulties in interpreting, as well as in expressing picture content. Low "pictorial capability" is largely true also for the teachers, who very often lack both education and training in visual language and in visual communication. This is quite remarkable since the curricula in Sweden both assume and require all teachers to be responsible for teaching about visuals as a means of communication. I agree with Larsson (1991) who wrote (p. 105, in translation): "... it is important that all persons involved increase their knowledge of pictures and the function of pictures in textbooks: teachers, pupils, publishers, authors, designers, artists". Gayer (1992) stated that different types of visuals can be of great use in education. She certified that it is a serious deficiency that many teachers have insufficient knowledge of how visuals function. We know that pictures can have a positive, a neutral, or a negative effect on learning (Levin et al., 1987; Sims-Knight, 1992; Winn, 1993; and Rieber, 1994).

Regardless of the intended functions pictures are not always used in an active way at school (Pettersson, 1990). On the contrary pictures in textbooks are often ignored and "skipped" (Lindström, 1990). Most students do not attend to the visuals unless they are instructed to do so (Reinking, 1986; Pettersson, 1990). Hannus (1996) used eye-movement equipment and studied how pupils picked up information while learning from textbooks. He concluded that the learning effects of textbook illustrations are slight because not enough attention is paid to the illustrations in the books. Thus the learning functions of illustrations were less than expected.

In some textbooks the purpose of many pictures seems to be purely decorative or entertaining and not at all cognitive. If a textbook has many pictures which only are decorative and entertaining, it may well contribute to "image overload" and cognitive pictures being skipped. This may be one reason for textbook pictures not being used effectively. In such cases pictures may actually decrease the quality of the textbook, and only raise its price. It is possible that certain types of illustrations, incorporated to "stimulate" the reader's imagination and interest, could instead have a heavily governing effect which stifles the imagination and diverts interest from the information the author wishes to convey.

As seen from the opinions presented by the teachers visuals that are used in teaching may have many different purposes. This raises quite high demands upon teachers as well as pupils and students and strengthen any requirements for education and training in visual communications. The reader should always be encouraged to find out what the senders' intentions are.Why is the picture there? What is the function of the picture? What is the main message? Which are the secondary meanings? Which associations does the picture raise?

Information design and image functions

There is often a clear difference between the intended and the perceived message (Pettersson, 1985). One way to decrease this gap is to supply all pictures with interesting and explaining captions, supporting the intended interpretations (Melin and Pettersson, 1991). When too many pictures of different types are used in one single message, some of the pictures may be ignored. There will also be less space for the text. Unfortunately, often archives pictures are used in a way not intended. Sometimes the same pictures appear in several different contexts, which may confuse the readers. Some illustrations in contemporary textbooks appear to serve no useful purpose at all . Some picture editors admit that some of the pictures they put into textbooks are only there to "stimulate" the reader, to have "a life of their own," or merely to provide a "breathing space" within the text. Such uses seem very dubious. In fact some publishers admit that the two main reasons to use pictures in their books are to (1) *attract buyers* and (2) *increase the prices*.

Interviews with editors, art directors, and designers from major Swedish publishing houses showed that they, in the selection of visuals for reference books and textbooks, often ask themselves questions such as the following (Pettersson 1989:145):

- Does the picture depict the right thing?
- Is the presentation of the subject satisfactory?
- Is the picture technically acceptable?
- Is the picture aesthetically satisfactory?
- Is the picture "flexible," i.e., will it work with different formats?
- Will the picture fit into a given area?
- Will the picture fit in with the other pictures on the same page?

In practice, many editors, art directors, and designers find that (1) *procurement time*, (2) *availability*, and (3) *image clarity* are the most important considerations in making their subjective choices among possible visuals. Evans, Watson and Willows (1987) interviewed editors, art directors, and designers from nine major Canadian publishing houses. They concluded (p. 90):

> Our interviews confirm Dwyer's (1972) summary that the selection and inclusion of illustrations in textbooks appear to be based on "subjective feelings of the designer about what is best, the accessibility of raw information, the availability of materials, the cost, the attractiveness of the finished product, and the availability of a ready market" (p. 16).

Marsh (1983:101) provided the following eight guidelines for selecting a visual channel for a message:

- When messages are complex.
- When referability is important.
- When messages are long.
- When environment is noisy.
- When arrangement is complicated.
- When precise spatial discrimination is important.
- When simultaneous presentation is desired.
- When more dimensions are required.

Selection of artistic style for visual materials should not be an arbitrary decision, but always a conscious one. Although full-colour photographs increase the costs of trade-books Ramsey (1989) suggested that publishers should increase the number of such books available for primary audiences. Today, however, there are only few informational books for children which meat these criteria. It is actually quite common that various kinds of abstract illustrations are used in textbooks. In my view visuals for information should be attractive but "unambiguous", i.e. not too "artistic" and therefore ambiguous. Visuals that are attractive and that people like also have greater impact. To increase interest in a material it might be a good idea to use a blend of several kinds of visual types such as diagrams, drawings, and photos. Generally speaking it is not possible to rank the different types of visuals. Often the type of visual which should be used must be determined in each individual case with a view to various demands on the picture and the prevailing budget framework. It is often easier to control the production of a drawing than the production of a photograph. So a drawing may be the only realistic alternative in many situations. However, since pictures illustrated in more abstract styles, such as cartoon and expressionistic, might generate more imagination such pictures might be used as stimuli for creative writing assignments.

It is not enough to select good visuals and make sure that all the pictures have relevant captions. To really help the readers to improve their use of visuals in textbooks, AV-material, and other teaching aids, we should give the teachers careful guidance, for instance in a teachers guide. The guide should:

- Show the purpose of each individual picture.
- Complete the caption and tell what each picture shows.
- Give different examples of how every picture can be used in the education, what is important to discuss, which tasks can be assigned in connection with the picture, and so on.
- If needed provide complementary facts, for instance explain how the picture has been produced.
- Account for name of photographer, artist or other picture creator.
- Effective visuals for information should create an experience for the reader. The reader must:
- See or rather "discover" the picture.
- Pay attention to the picture.
- Read the picture in an active and selective way.
- Process the information mentally.

Winn (1993) concluded that pictures play many roles in instruction. It is therefore necessary to know precisely what a picture's function is intended to be before it is designed. Cognitive and decorative functions should never be confused or mixed (Pettersson, 1989). At some point illustrations move from being engaging motivators to engaging distractors (Evans, Watson and Willows, 1987). When too many pictures are used, readers may ignore many of them. Massoumian (1989:19) noted that "haphazard use of visuals may lead to minimal or no instructional gain and gradual loss of effectiveness as an instructional tool."

In information design it must be possible to understand the message and to be able to believe that the information is correct. A message with high credibility has a good structure, convincing arguments, proper references, and relevant examples. It is a major advantage if text and pictures have good legibility as well as good readability. In my view a picture used in information materials should depict reality in a manner appropriate to the content and be as relevant and credible as possible. However, many pictures in textbooks and newspapers have been edited in order to change their importance and impact. Pictures can easily be enlarged or reduced in size, which will influence readability. It is often very easy to crop the original picture.

However, cropping is not merely an aid to art or to journalism; it may also be a tool for unscrupulous editors. Many photographs lend themselves to manipulation of the representation. They are susceptible to different crops to support different meanings and various ideas. It is also possible to expand the original picture. Parts of the picture can be deleted, added, altered, moved or changed in shape. A colour can be changed, removed or added. This practice of editing is often unlawful.

Visuals cost money, often quite a lot of money. But in many situations a "good" picture need not cost more than a "bad" picture! Spending a lot of time on the visualization process and on sketches (usually a less expensive process than the cost of originals, "masters", and printing runs) may therefore be worthwhile.

Conclusions

Visuals may have many functions in communication. The lists presented in this paper presents hundreds of opinions about image functions. More than one hundred different explanatory verbs are used to express these opinions. According to researchers in the areas of instructional message design, visual literacy, and visual communication the most common opinions on functions of visuals concern *attention*. Attract, gain, get, hold and maintain attention are mentioned by the researchers. Other common explanatory verbs are: *facilitate, provide, persuade, create* (an interest in), *illustrate, clarify, motivate, present,* and *reinforce* information (to someone).

The inquiries with students and teachers also showed that there may be many purposes for the use of visuals in printed media. Most of the purposes can be looked upon as clearly pedagogical or cognitive, in contrast to pictures used for entertainment, decoration, advertising or marketing. The most common purposes of pictures in the school environment were to: *show, explain, visualize, illustrate, clarify, inform, summarize, convey, mediate, elucidate, present,* and *give* (perceptions), *instruct, describe,* and *entertain.*

The most common purposes of pictures in information design are to *visualize*, *clarify, inform*, *attract attention*, *facilitate reading*, *explain*, and *convey information*. The type of visual to be used in the production of materials for information and learning must often be determined in each case with a view to specific demands on the visual, and also to the prevailing budget framework.

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Assessing image contents

Abstract. *This paper includes a discussion of methods for assessing image contents. It is relatively easy to assess concrete image contents. However, it is not at all as easy to measure aspects of abstract image contents. A subject matter can be depicted with many different kinds of pictures and a single picture can be perceived in many different ways. In order to be able to produce better information materials we need to study the importance of various variables in visual language. We need to further develop methods for measuring image properties.*

Introduction

There are many different kinds of visuals, and they can be classified according to various criteria. Generally speaking scholars agree that complicated language, in both texts and pictures, will impair the understanding of any intended message. Text and pictures for information should be designed so that they are easy to read. Any graphical message should be legible, readable, and also well worth reading for the intended audience. Any audial message should be audible, distinct, and also well worth listening to for the intended audience. The message may be aesthetically pleasing, but its content is more important than its form.

In order to further develop information materials we need to be able to find ways of comparing the advantages and disadvantages of various variables in visual language. We need to develop methods for assessing and measuring image properties, and perception of images. In this paper I discuss methods for assessing and measuring concrete and abstract image contents, and I compare the importance of two different means of production.

Classification of visuals

Visuals can be classified according to various criteria, such as sender, receiver, content, execution, context, and format, and even according to criteria such as function, use, and the means of production, etc. In picture archives, pictures may be stored, e.g., according to content categories.

Doblin (1980) classified iconographic (visual) information into several categories: *ideogrammatic* (symbols that attempt to convey a single meaning, such as a road sign), *diagrammatic* (charts, graphs, or diagrams), and *isogrammatic* (photography, drawing, and drafting). Hunter, Crismore, and Pearson (1987) presented a classification as points along a continuum from realistic to abstract: photography, artwork, diagrams and maps, graphics and formulae, tables and charts, and orthography (icons). In their study on *Visual Displays in Basal Readers and Social Studies Textbooks*, they used the following categories: sequential graphs, quantitative graphs, maps, diagrams, tables and charts, and verbal-visual displays.

For Wileman (1993) all kinds of representations of an object are *symbols*. He argued that there are three major ways to represent objects: as (1) pictorial symbols, as (2) graphic symbols, and as (3) verbal symbols – ranging from concrete to abstract representations. The first group, pictorial symbols, includes photographs and illustrations or drawings. Viewers should easily be able to translate a pictorial symbol to a real-world example. The second group, graphic symbols, has image-related graphics, concept-related graphics, and arbitrary graphics. Image-related graphics can be characterized as silhouettes or profiles of the object. Concept-related graphics look like the object but have less detail than image-related graphics. Arbitrary graphics are abstract symbols for objects, constructed out of the designer's imagination. The third group, verbal symbols, is divided into two sub-groups, verbal descriptions and nouns or labels. Only people who comprehend the language used to describe the objects can understand verbal symbols.

There seem to be no major difference in "abstractness" between abstract arbitrary graphic symbols and verbal symbols to me (Pettersson, 1993). Thus, I prefer to talk about two categories of representations: (1) figurative and (2) non-figurative. Figurative representations include two groups, visuals and graphic symbols. Visuals include three-dimensional images, photographs, realistic drawings, and schematic drawings. Graphic symbols include pictorial symbols, abstract symbols, and arbitrary symbols. Non-figurative representations or verbal symbols include verbal descriptions, nouns or labels, and letters and characters.

There are many more possibilities for classification of visuals. One way is the *style*. Sloan (1971) discussed four pictorial artistic styles, (1) photographic, (2) representational, (2) expressionistic, and (4) cartoon. *Photographic style* was defined as a colored photograph of the subject. Representational style was defined as an artist´s rendition of the subject which conforms to the subject in its true form. *Expressionistic style* was defined as an artist's rendition of the subject, which leans heavily towards abstraction. *Cartoon style* was defined as an animated caricature of the subject. These four artistic styles form a realistic to an abstract continuum.

Dondis (1973) discussed the *anatomy* of a visual message, another kind of style. According to Dondis we express and receive visual messages on three levels; (1) representationally, (2) symbolically, and (3) abstractly. Representational forms of illustrations are actual photographs of things. In symbolical forms pictures show one thing and connote another. In abstract forms illustrations provide minimal visual information on the phenomenon illustrated.

In addition to size, shape, color etc., the way pictures are shot is important. With reference to the distance to and size of the motif, photographers may classify pictures as long shots, full-length portraits, half-length portraits, and close-ups. The *aesthetic value* of a long shot is different from that of a medium shot or close-up. According to Zettl (1990) a scene can be presented (1) objectively (usually a long shot), (2) subjectively (usually a close-up), or (3) creatively (created by the medium itself, for example, superimposition, picture montage, etc.). Metallinos (1990) developed a schema, which explains these three forms of picture presentations in accordance with their functional aesthetic value. We can (1) remain totally objective and look at an event and, (2) become subjectively involved and look into an event; and (3) where the event is totally dependent on the medium for its existence we can create an event.

Measuring concrete image contents

The *execution* of a visual can be measured by objective as well as by subjective methods. However, the *image contents* may only be assessed and measured by subjective means. Variables in visual language have functional as well as suggestive properties (Pettersson, 1989). The functional properties are related to cognitive factual information in content, execution, context, and format. The suggestive properties are related to emotions, conceptions, aesthetic perception, tension, fright, etc.

Functional properties predominate in symbols. They are also more important than suggestive properties in informative and educational pictures, since their task is to convey certain information in the most effective manner possible. The objective for a picture for information may also be to convey certain emotions and arouse the viewer's interest and involvement (e.g., regarding conditions in other countries and cultures, or in past times).

Suggestive properties are more important than functional properties in "artistic pictures". Art is not primarily a question of objects. It is more a visual language for dissemination of ideas and experiences that are difficult to put across in words. Irrespective of the sender's intentions, different receivers may respond in an emotional manner to a picture with mainly functional properties. In the corresponding manner, some viewers may respond unemotional and functional to pictures with predominantly suggestive properties.

In the USA more than 50,000 high school, college, and adult learners have participated in more than 200 visual research studies. Dwyer has reported results from these studies several times (1972, 1978, 1982-3, 1985, and 1994). Throughout these studies, continuity was maintained by utilizing the same 2,000 word instructional unit on the human heart. Visuals range from simple line drawings to realistic photographs, in black and white as well as in color. A variety of presentation formats, such as booklets, television, and slide-audiotape presentations have been used in these studies.

Pictures with concrete contents have also been used in a number of other studies. In several experiments subjects have been given various assignments. Thus subjects have been asked to name image contents, to describe image contents, to index image contents, to write legends, to assess image contents, to create images, to complete a story, to illustrate a story, to produce information sets, to produce information graphics and to describe picture context. See Cohen, Ebeling, and Kulik (1981), Goldsmith (1984, 1986), and Pettersson (1989, 1993) for reviews of such studies.

Figure 1. Concrete image content "Two house martins."

Pictures which are easy to read are usually rated as aesthetically pleasing and suitable for use in the dissemination of concrete information (Pettersson, 1986). Here, we often find a close agreement between intended and perceived image contents. It is relatively easy to assess and measure concrete image contents. However, it is not at all as easy to measure aspects of abstract image contents.

Measuring abstract image contents

In one study (Pettersson, 1985) the objective was to examine the degree to which intended image contents coincided with perceived image contents. The study was performed as a joint project by Stockholm University and RMI-BERGH, a Stockholm Art & Design School.

The students selected five abstract concepts: (1) togetherness, (2) credibility, (3) aggressiveness, (4) courage, and (5) suspiciousness, and produced five drawings and five photographs for each topic. The pictures were all mounted on cardboard papers in the A3 format (29.7 x 42.1 centimeters). The art students and their teachers were called the "sender group" (46 persons). The members of this group individually ranked all the pictures and selected one drawing and one photograph to represent each topic. Then they individually rated how well the contents of each picture corresponded to the picture's intended contents on a semantic scale. The verbal ratings "very poor, rather poor, neither poor nor good, rather good, and very good," were supplemented with a numerical scale from zero to one hundred. In this scale very poor is 10, rather poor is 30, neither poor nor good is 50, rather good is 70, and very good is 90. This type of combined verbal and numerical scale had been used in previous studies (e.g. Gabrielsson et al. 1983, Pettersson et al. 1984), since it makes possible statistical analysis of verbal ratings.

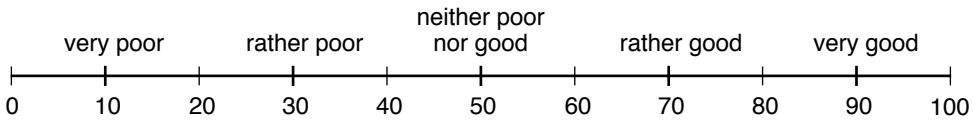

Figure 2. An example of a combined verbal and numerical semantic scale.

Later representatives (40 university students, and 40 high school pupils) for intended "receivers" individually rated perceived image contents of the pictures according to the same semantic scale. The results showed that (1) a subject matter can be depicted with many different kinds of pictures, and that (2) a single picture can be perceived in many different ways. There was a poor agreement between the intended and the perceived interpretations of these abstract image contents. The drawings conveyed intended messages somewhat more successfully than the photographs. The results also suggested that "qualitative" picture studies shall be undertaken with great caution, since people perceive the same picture in so many different ways. It seems that the only way to assure that information conveyed by pictures is clear and unambiguous is to pro-vide a caption for each picture.

Figure 3. Abstract image content "Togetherness."

According to the sender group, most of the pictures were about "rather good". Eight pictures received mean ratings from 63 to 75. One was rated lower (57) and one was rated higher (85). Relatively large standard deviations (around 21) reflected large inter-individual differences in the subject ratings. In nine out of ten cases, there was no difference between the female and male members of the sender group.

The university students matched the sender group fairly well in terms of age structure. However, their perception of the pictures differed. One of the pictures was assigned a higher rating, three were rated the same, and six received lower ratings. An even greater spread in standard deviations (17 – 27) indicated wider inter-individual variations in ratings. A gender-based analysis of the ratings disclosed that the females in the sender group and the female subjects in the receiver group were in much greater accord than the corresponding male groups. The women rated four pictures differently, and the men rated six pictures differently. High school pupils ratings of five pictures were significantly different from sender group ratings.

In a follow-up study, slides were made of the five drawings. These slides were then projected to and rated by 113 adult subjects at the UREX image laboratory in Finland. The subjects in Finland rated the pictures very much the same as the subjects had done in Sweden. In Finland 68% of the subjects rated the images as "rather good" or "very good" according to a Likert scale (very poor, rather poor, rather good, and very good). The abstract image contents were more important for the subjects than the format of the images.

Weidenmann (1989) studied underevaluation of pictures. In an experiment, 206 male students rated the "perceived quality" of five materials on leadership. The five versions were:

1. text
2. text with "imagination instructions"
3. text with pictures and no instructions
4. text with pictures and picture-oriented instructions
5. text with pictures and imagination instructions

The "illustrated text with picture-oriented instructions"-group rated the material more positively with respect to four factors: (1) comprehensibility, (2) concreteness, (3) attractiveness, and (4) memorability. The three groups with instructions in their texts each rated the material lower in scientific "seriousness" than did the two other groups. After two weeks 159 subjects received a questionnaire concerning main ideas and details of the text. Results showed that the "illustrated text with picture-oriented instructions"-group recalled significantly more main ideas and details of the text than did all other groups. The differences among the other four groups were statistically equivalent. It can be concluded that an underevaluation of pictures can be compensated for by explicit picture-oriented instructions. In materials for information and instruction pictures need legends.

Importance of the means of production

The introduction of personal computers and different software packages have changed the way many people work. This is true for writing of text, and also true for the production of many kinds of visuals, especially schematic pictures and different kinds of graphics. It is easy to change the typography of a text and thus adopt the legibility of that specific text for different media and for different audiences. But how do people perceive text and pictures with different *styles* that are dependent on the means of production?

Objective

In a recent study at the department of Information Design at Mälardalen University the objective was to *examine if the means of production of a message will influence our perception of that message*.

The specific research question was: "Are there any general differences between traditionally hand-made and computer generated pictures?" The hypothesis was that computer generated pictures will provide a "better experience" for the receivers than hand-made pictures with the same subject matter will be able to do. We anticipated that receivers should find that computer generated messages will provide better legibility, better readability, better reading value, better aesthetic value, optimal image complexity and also better credi-

bility. There are a number of sources of possible errors for all kinds of qualitative studies of pictures, of visual language and of combined verbo-visual messages. It may be hard, or it may even be impossible to draw any general conclusions from a limited number of experimental pictures and a limited number of subjects, even if they are statistically selected at random. Also, the skill of individual fine artists and the skill of individual illustrators or photographers will influence the quality of the final pictures. Receivers will probably always have their individual preferences and interpretations with respect to the visuals that we use for information sets and learning materials. If a teacher acts as a leader for a visual language experiment this may also influence our student subjects. However, we have tried to design this study in order to reduce the importance of these different problems.

Definitions

In this study the six main concepts that we have studied were described in the following way.

Legibility. The message's legibility is determined by the technical design of the text and the pictures, that is, their clarity. We should avoid unusual typefaces, as well as typefaces that are too small or too large. Typeface and font size must be adapted partly to the medium and partly to the choice of technical production. A drawing has good legibility if it is easy to read, from the viewpoint that the reader should easily be able to see and distinguish all the different parts of the picture. Legibility can be measured rather objectively, and its quality is assessable whether we understand the content of the message or not.

Readability. What makes a message difficult to read is not as often the subject matter as the style. The choice of words, symbols, and picture elements creates the style. The readability is determined by content and formulations, and how well the language and style is adapted to the readers. A drawing style that includes many different kinds of patterns, shadings, and lines, and inconsistent use of symbols may obstruct the reading of the pictures. A schematic picture has good readability if it is easy for the reader to understand the message.

Reading value. The message should be well worth reading. This designates the properties of the content of a message and is very subjectively dependent on the reader's degree of interest in the message. Each group of readers selects information material on the basis of her or his personal preferences. What is interesting for one person may be perceived as boring by another person. The same message may be interesting at one instance but uninteresting at another occasion.

Aesthetic value. The aesthetic value of a message is how the intended receivers perceive it with respect to beauty. Aesthetics aims to establish the general principles of art and beauty, harmony and proportion. Material with a (suffi-

ciently) pleasing aesthetic form has greater potential for conveying a particular message than does unaesthetic material.

Complexity. A visual should usually possess a moderate and selected degree of realism and complexity. Too little or too much realism in a visual can interfere with the communication and learning processes. A visual should contain the details that are essential in communicating the intended message. Too many details and too much complexity reduce the interest for the content in the visual. Too few details or too little complexity makes it impossible to understand the picture.

Credibility. We believe in a message with high credibility. We may influence the credibility of text and pictures. It must be possible to understand the message and to be able to believe that the information is honest and correct. A high credibility message has a good structure, convincing arguments, proper references, and relevant examples. High-credibility sources exert a more persuasive influence on the receivers than low-credibility sources.

Experiment

Together with a teacher the "sender group" (36 illustrator students at the Department of Information Design) discussed their part in the experiment. They were asked to select six *topics* and produce information materials, "messages." The group selected the following topics: (1) a city plan showing the location of the Department of Information Design in Eskilstuna, (2) the information design program for illustrators, (3) the development of rust, (4) student admissions to the programs in information design, (5) the life of the flea, (6) the Rothof City Park in Eskilstuna.

Each member of the sender group selected one topic and then produced one traditionally hand-made picture in color, and also one computer generated picture printed with a color-printer as well as a caption explaining the picture. All these 72 pictures were then mounted on cardboard papers in the A3 format (29.7 x 42.1 centimeters) together with their captions.

The members of the sender group individually *ranked* all verbo-visual messages and selected one to represent each topic. Then they individually *rated* how well the contents of each message corresponded to its *intended contents* on six semantic scales, adopted for each of the six concepts and based on the semantic scales used before. The verbal ratings "very poor, poor, neither poor nor good, good, and very good," were supplemented with a numerical scale from zero to one hundred. In these new scales very poor is 10, poor is 30, neither poor nor good is 50, good is 70, and very good is 90.

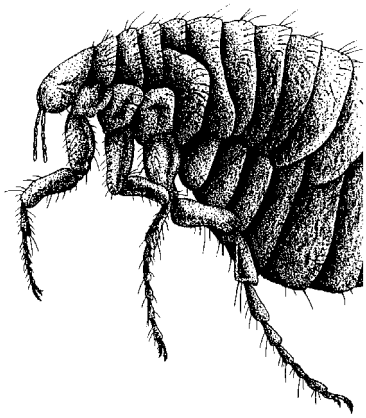

Figure 4. Part of the topic "The life of the flea", hand-made.

Administered by a research assistant 26 of the senders made a total of 1,872 ratings. For each scale the verbal ratings were supplemented with a numerical scale from zero to one hundred. Later the intended "receivers" (47 other information design students) individually rated the *perceived contents* of the messages according to the same semantic scale. The receivers made a total of 3,384 ratings. Thus the project included 5,256 ratings. The statistical analysis showed the hypothesis to be true. In this study the means of production influenced the perception of the messages. Subjects seem to "like" or "dislike" an information material.

A 2x2x2x2x6 analysis of variance with *group* (sender, receiver), *ill_ed* (illustrator, editor), and *gender* (male, female) as grouping factors and *means of production* (manual, computer generated), and *topic* (city plan, program, rust, admissions, flea, and the park) as repeated factors. A factor analysis of all the data showed that legibility, readability, reading value, aesthetic value and credibility all were rated in a similar way. These factors represent a *general attitude* towards the messages. Each message was judged somewhere on a "poor to good-scale".

The subjects in the sender group as well as the subjects in the receiver group liked the computer generated pictures (M = 62.5) better than the pictures produced in a traditional manner (M = 57.8). Thus computer generated pictures were better than traditionally produced pictures [F (1, 66) = 9.59; p = .003]. The difference is small, but statistically significant (Figure 5). The short horizontal lines above and below the black dots in figures 5, 6 and 7 show the confidence intervals (95%). According to the "good-bad-scale" the value 50 represents a "neither poor nor good picture", and 70 represents a "good picture".

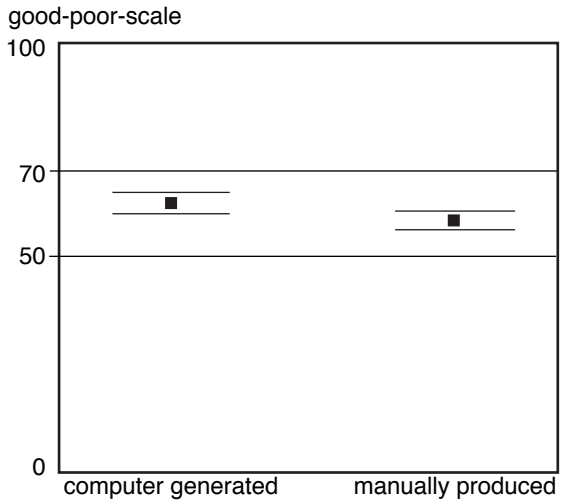

Figure 5. Mean assessments of means of production.

Regardless of the means of production the assessments of the various topics were significantly different [F (5, 330) = 19.85, p < .0001] (Figure 6).

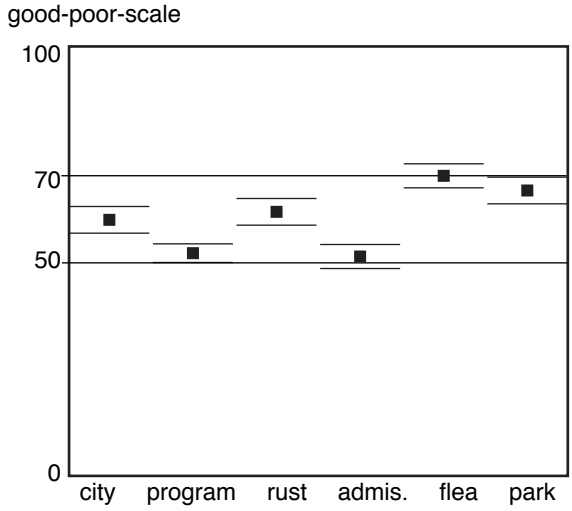

Figure 6. Mean assessments for six topics.

The subjects in the sender group were more pleased with the information materials (M = 61.9) than the subjects in the receiver group (M = 59.1) [F (1, 66) = 3.94; p = .051]. This corresponds well with the previous study of intended and perceived image

contents. Ratings made by females (M = 61.9) and males (M = 57.2) disclosed that the females in the sender group and the female subjects were in greater accord than the corresponding male groups [F (1, 66) = 5.90; p = .018]. However, the difference is small (Figure 7). This was similar in the previous study of intended and perceived image contents.

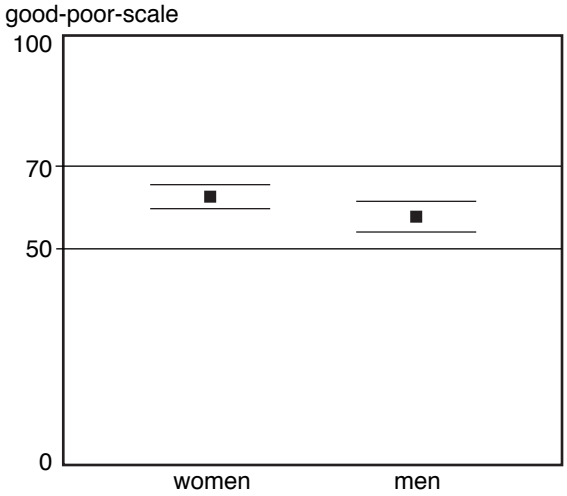

Figure 7. Mean assessments for female and male subjects.

There was no differences between the two means of production for the complexity factor [F (1, 66) = .02; p = .9]. However, there were clear differences between the topics with respect to the complexity factor [F(4.03, 265.8) = 3.2; p = .014]. In this scale pictures with low ratings are complex and they have many details. Less complex pictures have fewer details and they get high scores. In this study most pictures were rated close to the middle value "neither complex nor simple". The assessment of the complexity factor varied with the gender of the subjects [F (4.03, 265.8) = 2,68; p = .032].

The female subjects (46.9) accessed the pictures as less complex than the male subjects (44.8) did [F (1, 66) = 5.23; p = .025]. As the case with the good-poor-scale the sender group (47.9) assessed the complexity factor as different from the assessment of the receiver group (45.1). [F (1, 66) = 6.48; p = .013] However, both groups are close to the value of "neither complex nor simple". The mean assessments for the six different topics were: city plan 51.4, program 41.9, rust 42.7, admissions 47.5, flea 46.7, and the park 46.6.

Conclusions

It is relatively easy for subjects to assess concrete image contents. However, it is not at all as easy for subjects to assess and to measure aspects of abstract image contents. The results from these experiments and studies showed that a subject matter can be depicted with many different kinds of pictures and that a single picture can be perceived in many different ways by different subjects. In these studies contents was more important than format. In materials for information and instruction pictures usually need to have legends. In order to be able to produce better information materials we need to study the importance of various variables in visual language. We need to further develop methods for assessing and measuring of image properties.

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Kinship diagrams

Abstract. *This study presents 36 kinship diagrams based on more than 3 500 statements. Kinship diagrams may be used as one of many tools when we want to study the relationships of views on image contents. Pictures can generate a great variety of associations in audiences. Different assignments to a picture will influence its meaning in the mind of the viewer. A picture may always be interpreted in different ways.*

Associations

Pictures can generate a great variety of associations in audiences. In my study "Interpreting Image Content" (Pettersson, 2001) I concluded that:

- Different assignments to a picture will influence its meaning in the mind of the viewer.
- Realistic photographs can generate a great variety of associations in audiences. Visual experience is subject to individual interpretation.
- Humans, especially their faces, are the kind of image content that will get maximum attention.
- Quite often perceived image content is different from intended image content.
- In information design it is not sufficient merely to choose and use good pictures. In information and instructional materials pictures should always have captions to guide the understanding of their intended content.

Interpreting image content

Students at the Department of Information Design at Mälardalen University answered four questions regarding nine photographs:

1. What does this picture represent?
2. What happens in the picture?
3. What do you think of when you see this picture?
4. Why do you think so?

The intended image contents are:

1. A group of five lemurs at Skansen, the zoo in Stockholm, Sweden.
2. The Niagara Falls in Canada.
3. A Chinese carnival in Washington DC, USA.
4. A part of Kungsträdgården, a park in central Stockholm.
5. A part of the harbor in Stockholm.
6. Busy traffic in Athens, Greece.
7. An airplane at the airport in Jackson Hole in USA.
8. A dead bird washed up on a sandy Japanese beach.
9. Pont du Gard, an old Roman aqueduct in France.

Figure 1. A group of five lemurs at Skansen, the zoo in Stockholm.

Figure 2. The Niagara falls in Canada.

Figure 3. A Chinese carnival in Washington DC, USA.

Figure 4. A part of Kungsträdgården, a park in central Stockholm.

Figure 5. A part of the harbor in Stockholm.

Figure 6. Busy traffic in Athens, Greece.

Figure 7. An airplane at the airport in Jackson Hole in USA.

Figure 8. A dead bird washed up on a sandy Japanese beach.

Figure 9. Pont du gard, an old Roman aqueduct in France.

Pictures including "faces" (1, 3, 4 and 7) caused more words per answer (M = 9.1) than "technical pictures" (2, 5, 6, 8 and 9) (M = 7.6). (See table 4.) Question 1. "What does this picture represent?" and question 3 "What do you think of when you see this picture?" need a smaller amount of words than question 2 "What happens in the picture?" and question 4 "Why do you think so?". For each picture and for each question the *total number of words* as well as *the sum of the top five words* were calculated.

Table 1. Frequency index.

Picture	Questions				M
	Q1	Q2	Q3	Q4	
1	23	11	7	6	12
2	42	19	7	6	19
3	14	7	5	4	8
4	17	11	14	4	12
5	31	16	22	5	19
6	17	15	10	6	12
7	22	19	4	5	13
8	42	18	15	7	21
9	18	17	11	6	13
M	25	15	11	5	14

A *frequency index* showed a diversity of the opinions about the pictures. This index was calculated as the sum of the five most frequent explanatory words expressed as a percentage of the whole number of words for each picture and each question (table 1). High index values indicate that many subjects have the

same opinions, expressed by words redundant to the image content. Low index values show that people have many individual opinions expressed with different kind of words.

The "face group" (M = 11) has lower frequency index values than the "technical pictures" (M = 17). The first question "What does this picture represent?" had the highest mean index values. The other questions have a declining level of consistency and an increasing number of individual expressions. Table 2 presents the number of different answers as a percentage of the total number of answers for each of the four questions. This may be called an "Answer Index".

Table 2. Answer index.

Picture	Questions				M
	Q1	Q2	Q3	Q4	
1	73	94	89	95	88
2	25	93	85	99	76
3	95	99	90	100	96
4	88	93	86	98	91
5	76	84	80	99	85
6	82	98	82	100	91
7	69	86	92	100	87
8	47	79	83	100	77
9	66	86	89	100	85
M	69	90	86	99	86

Pictures including "faces" (1, 3, 4 and 7) has higher answer index values (M = 90) than the "technical pictures" (2, 5, 6, 8 and 9) (M = 83). As we can see in table 2 almost all subjects have different answers to Q4 "Why do you think so?" (M = 99).

Developing kinship diagrams

When people express similar views and similar opinions they may sometimes use exactly the same words in the same sentences. However, they may also use synonyms, near synonyms and related words to express what they mean. Some expressions may be different but at the same time express a kind of "kinship" with one another. Thus, from a practical point of view, rather different paragraphs of texts may convey "the same" message.

If all subjects in a study provide exactly the same answer to a question this can be represented in a diagram with one single, large circle. If they all provide different answers this can be represented with one hundred circles distributed

in the diagram. For each image scales with opposite concepts will be used. Placement, direction and distance subjectively represent the kinship between the opinions expressed by the subjects. We may then visually compare results from the different assignments.

A preliminary analysis of the opinions expressed by the subjects regarding two of the nine pictures and two questions provided four different kinship diagrams (Pettersson, 2001). Now it is possible to present kinship diagrams for all the combinations: a total of 36 kinship diagrams based on 3 522 statements (table 3) with a total of 29 125 words (table 4). The average sentence length is 8.3 words. See the kinship diagrams in figures 10 – 13.

Table 3. Total number of answers.

Picture	Questions				Sum
	Q1	Q2	Q3	Q4	
1	106	106	110	105	427
2	100	100	98	97	395
3	100	102	102	99	403
4	98	98	99	99	394
5	97	96	96	98	387
6	95	97	95	99	386
7	95	95	93	98	381
8	92	90	92	94	368
9	97	95	95	94	381
Sum	880	879	880	883	3522

Table 4. Total number of words in the answers.

Picture	Questions				Sum
	Q1	Q2	Q3	Q4	
1	723	957	846	1370	3896
2	337	802	724	1089	2952
3	941	1161	684	1105	3891
4	732	1174	530	1175	3611
5	574	852	541	938	2905
6	563	902	538	1106	3109
7	626	890	644	980	3140
8	490	651	413	1010	2564
9	647	895	550	965	3057
Sum	5633	8284	5470	9738	29125

In these kinship diagrams the number of answers, as well as subjects, range from 90 to 110. The average is 98 answers per picture per question. The number of subjects is noted for each kinship diagram as well as the "Answer Index". Thus the notion "Picture 2 (100 s, i 25)" should be read as: "This is the kinship diagram for picture number 2. There are 100 subjects, and the Answer Index is 25."

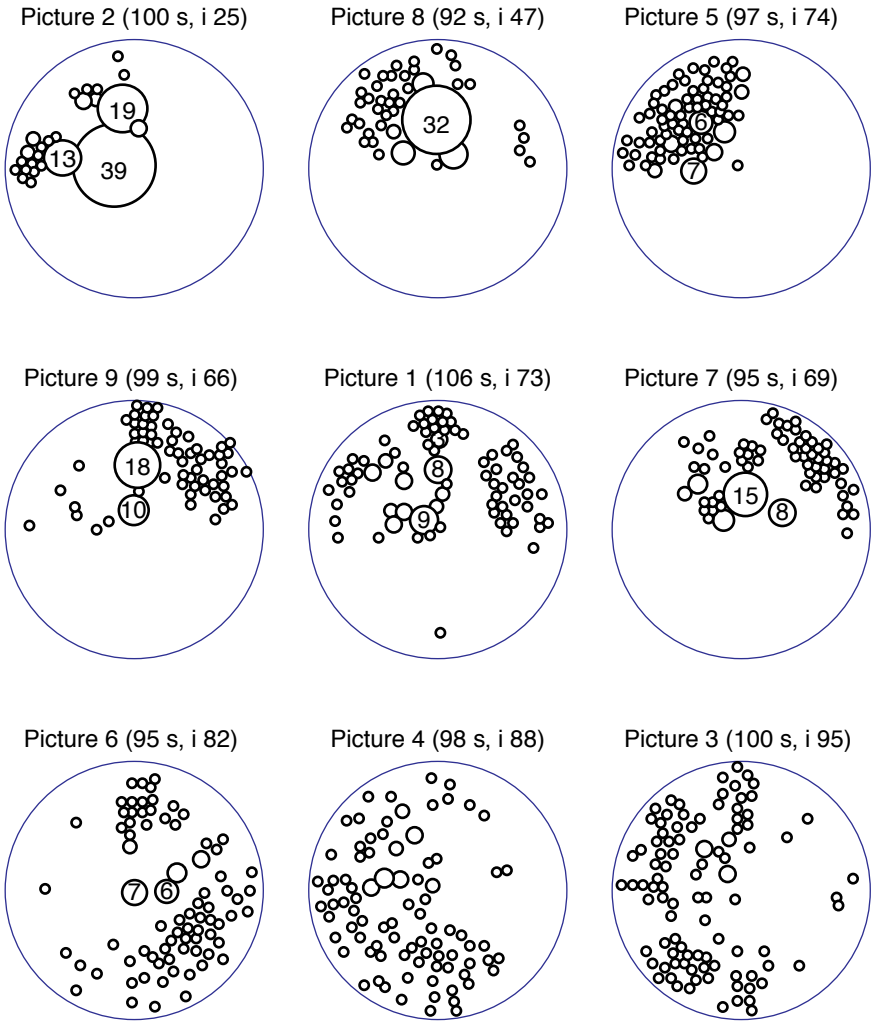

Figure 10. Q1. What does this picture represent?

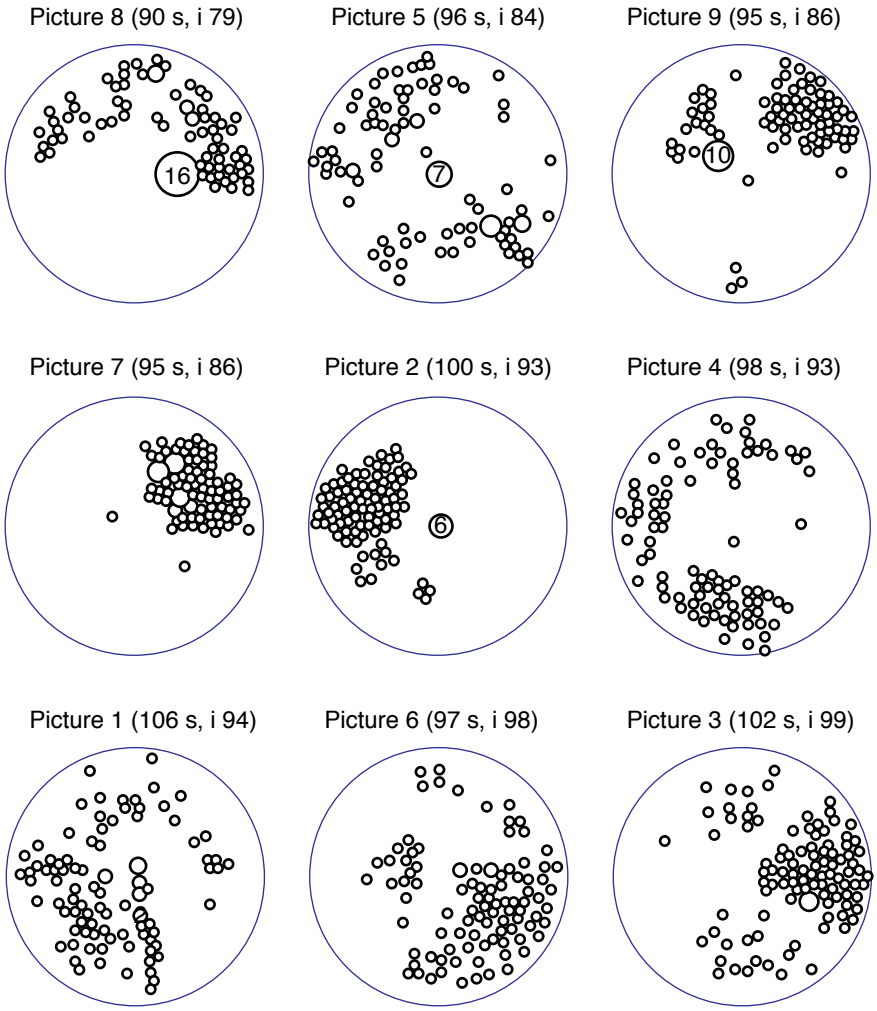

Figure 11. Q2. What happens in the picture?

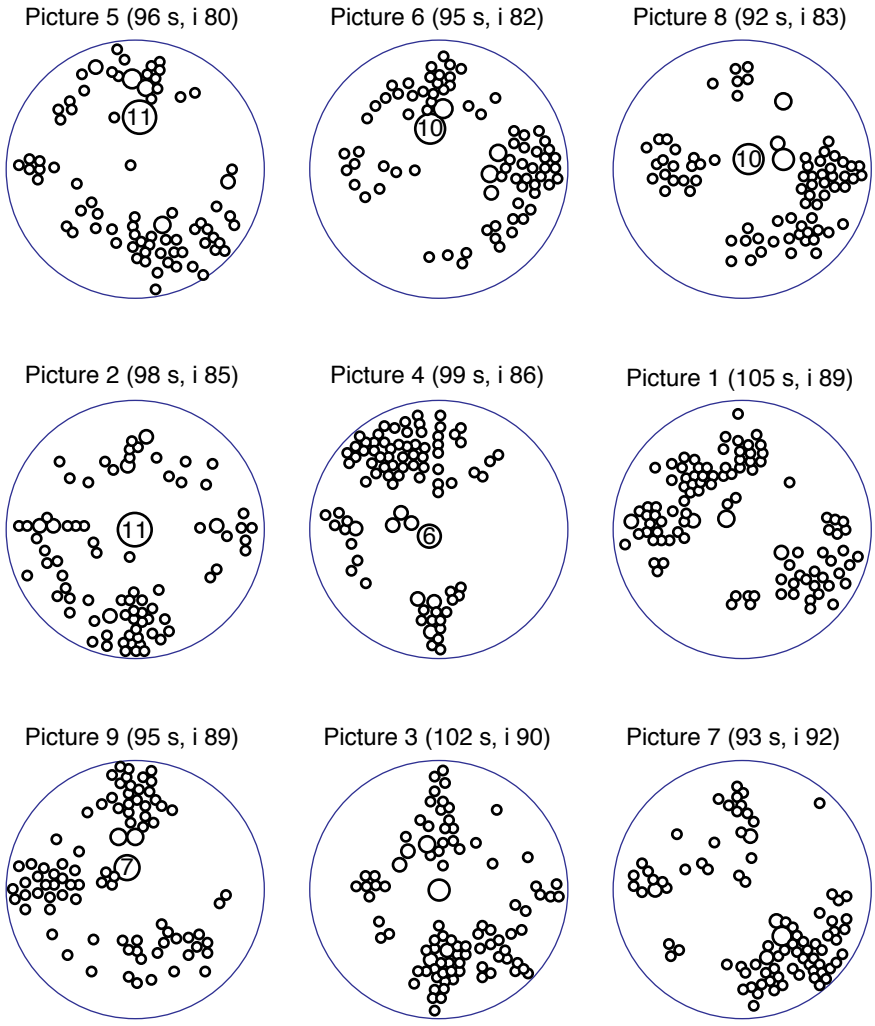

Figure 12. Q3. What do you think of when you see this picture?

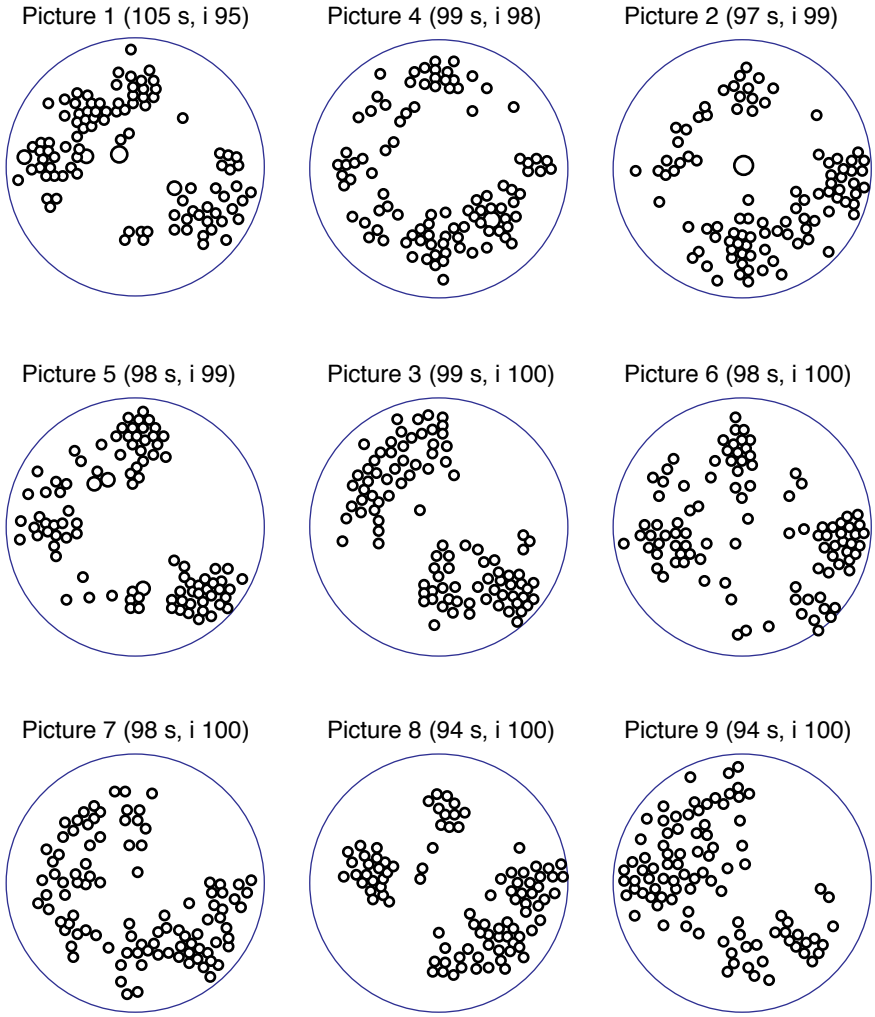

Figure 13. Q4. Why do you think so?

Discussion

There are differences and similarities between the kinship diagrams. For the first question ("What does this picture represent?") six pictures (1, 2, 5, 7, 8, 9) have rather "tight" diagrams. Here many subjects have expressed the same or very close opinions. For the second question ("What happens in the picture?") two pictures (2, 7) show tight diagrams. However for the third question (" What

do you think of when you see this picture?"), and the fourth question ("Why do you think so?") all diagrams show week kinship between the answers.

In a corresponding way an analysis with the "Answer Index" show a similar result. The first question has got the lowest mean index (Q1M = 69). Here only three pictures (3, 4, 6) have high index values. For the other questions all pictures have high (Q2M = 90, Q3M = 86) or very high index values (Q4M = 99). For five pictures (3, 6, 7, 8, 9) all of the subjects have expressed different opinions (index = 100).

Conclusions

It is quite clear that kinship diagrams and index values can be used when we want to compare verbal statements regarding visual contents. This study confirms the findings in the 2001 study.

- Different assignments to a picture will influence the meaning in the mind of the viewer.
- Realistic photographs can generate a great variety of associations in audiences. Due to every individual's experience the interpretations will differ.
- Humans, especially their faces, are the kind of image content that will get maximum attention.
- Quite often perceived image content is different from intended image content.
- In information design it is not sufficient merely to choose and use good pictures. In information and instructional materials pictures should always have captions to guide the understanding of their intended content.

Reference

Pettersson, R. (2001). *Interpreting Image Content.* Presentation at the 33rd Annual Conference of the International Visual Literacy Association. Mälardalen University, Eskilstuna, Sweden, November 7- 11, November 7-11, 2001. Published in: R. E. Griffin, J. Lee & V. S. Villiams (Eds.) 2002: Visual Literacy in Message Design. Selected Readings of the International Visual Literacy Association. International Visual Literacy Association.

Associations from Pictures

Abstract. *Pictures can generate a great variety of associations in audiences. Pictures can always be interpreted in a number of different ways, and that it is the texts that to some degree determine or revise our understanding of the pictures. There is often considerable disparity between the sender's "intended message" and the receiver's "perceived message". Indeed, it is sometimes doubtful whether the receiver has understood anything at all of what the sender wants to convey.*

In comparison to a written text, a visual contains an infinite amount of information (Pettersson, 1985). By selecting and utilizing different parts of the information in a picture on different occasions, we can experience completely new and different perceptions when we re-see a picture in new contexts. Like other languages, pictures consist of coded messages that are comprehensible in a given social context and in a given age. For example, we often find it difficult to interpret the messages in pictures from unfamiliar cultures and ages. "Modern art" puzzles its viewers who have not yet learned to decipher the new codes. The reader (viewer) always has greater freedom in interpreting a visual message than a verbal message. Pictures almost always convey multiple messages. Extraneous messages may compete with the messages the sender regards as significant and important. Thus, pictures always incorporate some ambiguity and numerous "correct" interpretations, although not always a picture's intended or anticipated interpretation. The way in which a picture is interpreted depends to a great extent on the reader's code in relation to the sender's code. Studies of intended vs. perceived image content give clear evidence that there are major differences between intended and perceived image content.

In recent studies, questionnaires completed by pupils and teachers show that there are many different purposes served by the pictures that are used in schools (Pettersson, 1990). Most of these pictures can be perceived as pedagogical or cognitive in purpose as opposed to pictures that are used to entertain, or as decoration, or in advertising and marketing. In one study made at the secondary school level, eighty-two pupils questioned mentioned 391 purposes in all, while forty teachers named 84 purposes (Pettersson, 1993). Many of the answers were similar, some were even synonymous or closely related to each other. By far the most common purposes of the pictures shown in school were

named as: showing, explaining, making clear, illustrating, informing, summarizing, elucidating, and conveying information.

Thus, pictures can have many purposes. This makes as great demands upon lecturers and teachers as it does upon listeners and readers. We should always be on the alert, ready to question what the author / photographer / artist / editor means with a picture. Why is the picture there in the first place? What is its function? What is the picture's denotation (i.e., primary meaning, basic meaning, main message)? What connotations (i.e., secondary or implied meanings) does the picture have? What personal associations does the picture awake in different persons?

As far as ambiguous pictures are concerned, there is often a major difference between their *denotation,* i.e., their literal meaning, and their various *connotations,* i.e., their associative meanings, and their *private associations* (Figure 1).

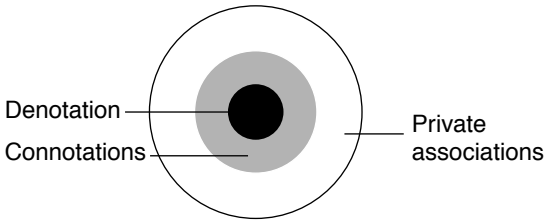

Figure 1. A picture can be interpreted in different ways by various persons. We can define fields of denotation (center), connotations (middle), and private associations (outer area).

In order to observe *the different private associations pictures awaken in people,* I have conducted two studies, one of which deals with *making associations from slides* and the other with *interpreting pictures in advertisements.*

Associations from slides

During the spring term of 1991, 25 students at Stockholm University took part in the study's first field experiment. The students were told that they would be shown three slides (slides 1, 2, and 3 below), and that on viewing each slide, they should write on a separate paper *the associations* called to mind by the image content in each slide. Slide 1 was projected for 30 seconds while the students wrote their associations. After these 30 seconds, the notes were gathered up. This procedure was then repeated with the two remaining slides.

Later that year, during the autumn term, another 27 students were tested. In the second test, two pictures were replaced by others, and the pictures were only projected for 20 seconds (slides 3,4 and 5 below).

Studies of eye movements have shown that it only takes a few seconds to *recognize* a "common" image content. In other words, on both of these occasions the students were able to *view* the pictures and understand the image content, but they were given no chance to actually *analyse* and reflect on the content of each picture.

Slide 1
Test pattern from Swedish Television channel 1. The first text line reads "TV1", the second "SWEDEN".

Slide 2
Stockholm's City Hall, seen from a bridge between Riddarholmen and Södermalm on a summer's day. A few white boats can be seen contrasted against the waters of Riddarfjärden.

Slide 3
Close-up of a dead bird washed up on a sandy Japanese beach. The bird is as large as a gull, and parts of its skeleton are clearly visible. There is no trace of oil or any other potential menace; the picture does not explain how the bird died.

Slide 4
A DC-3 flying low over Riddarfjärden in Stockholm on a cloudy day in late summer. The airplane's lights are on, shining clearly against a dark cloud.

Slide 5
Musicians dressed in brightly coloured folk costumes are playing at Skansen, Stockholm's outdoor museum. It is a bright summer's day.

The slides stimulated great variation in the number of associations different subjects experienced. Some subjects got only one association from a slide, such as "children's program" or "I turned on the TV too early" (slide 1), while other subjects produced long chains of associations, such as "TV - films - the news - sofa - tea and sandwiches - boring music - expectation" and "evening - film - candy - potato chips - fear - joy - loneliness - peace" (also slide 1).

In all, 385 associations were generated, 239 for the 30-second showings, 146 for the 20-second showings. In the first group, the average was 3.2 associations per person per picture. In the second group, the average was 1.8 associations per person per picture. The difference is most likely due to the viewing period being 10 seconds shorter for the second group, but as we saw above, the pictures were not the same in the two groups. For the picture viewed by both groups (slide 3), the average number of associations in the first group was 3.1, and in the second, 2.3.

In some cases, several people made similar associations. Four subjects, for example, thought only of "JAS" when they saw the picture of the plane (picture 4), and three subjects thought only of "Midsummer" when they saw the musicians (picture 5). (JAS is a fighter-plane developed in Sweden.)

From a pictorial perspective, some of the words the students wrote down were actually denotations and connotations rather than associations, in as much as they directly reflect the pictures' content. It is interesting to see how words of this type, with their natural linkage to a picture's denotation or connotation, constitute the starting point for *chains of associations* in several different subjects, and thus reflect the trains of thought in the subjects being tested. On viewing slide 2, for example, eleven of the 25 students chose the word *summer*, and proceeded to generate both short and long chains of associations, all of which terminated in different ways.

Summer – taking a walk home
Summer – getting lost in a tower
Summer – long walks – school outings – dizziness
Summer – sailing – bicycling through Stockholm – morning
Summer – sun – the leaning tower of Pisa
Summer – warmth – Stockholm – vacation
Summer – lovely – grandmother – boats – the archipelago
Summer – sun – sea – Stockholm – tourism
Summer – City Hall – Stockholm – steamboat – soot on my clothes
Summer – warmth – leisure time – beautiful – Swedish
Summer – warmth – joy – Drottningholm Castle – boat – taking a walk – trains

The word summer can also be found in chains of associations that begin with other words than summer.

Sun – *summer* – Stockholm
Stockholm – *summer* – drinking coffee by the water – warm
Stockholm – *summer* – warm – tourists – the Old Town
Stockholm – City Hall – *summer* – the Swedish flag

In other words, the students have thought of the same things to some extent, but not necessarily in the same order. Another example is the word *death*, which also led to various chains of associations.

Death – decay
Death – a cycle
Death – environmental pollution

Death – oil catastrophe
Death – a beach
Death – a beach
Death – look away
Death – a desert
Death – afraid of birds – sad
Death – the passage of life – the work of humans – disturbing
Death – the cycle of life – rot
Death – disgusting – war
Death – disgusting – oil
Death – yuck! – disgusting – but a lovely beach – oil
Death – disgusting – uncared-for – sandy beach – Gålö (Gålö is an island in the Stockholm archipelago)

Dead bird – environmental pollution – oil spills
Dead bird – sea – sand – oil – feathers
Dead bird on a beach – oil? – no, no oil on the bird – natural death

Like the word summer also the word *death* turns up later on in some chains of associations.

Cadaver – *death* – rot
Feathers – nature – *death* – sand
Bird – feathers – nature – *death*

As could be expected, to a great degree the summer pictures awakened positive associations. Examples of this are words such as: "drinking coffee by the water", "leisure time", "lovely", "warm breezes", "my wedding", "taking a walk", "fun time", "sun", "Stockholm's festival day", and "beautiful" (slide 2); as well as "folk music", "a cabin in the country", "Midsummer", "sun", "a fiddler's hoedown", "summer in Sweden", "warmth" (slide 5). But in these contexts even negative associations came up: "one of our worst summers", "a smarmy advertisement for Stockholm" (slide 2); and "hay fever" (slide 5).

The picture of the dead bird (slide 3) produced associations that can be perceived as negative. Some of these are: "death", "putrefaction" "destruction", "cadaver", "cold sand", "war", "oil spills", "environmental pollution", "environmental catastrophe", "disturbing", "rot", "the end", "sorrow", "desolation", and "adesert". Nevertheless, this picture did call to mind a few positive associations: "lovely beach", "an archipelago", "beauty", and "warm sand".

The picture of the airplane (picture 3) was widely felt to arouse negative associations: "the second world war", "threatening clouds", "the JAS project", "crash", "war", "accident" and "ashes". However, the picture did elicit a few positive associations: "a charter trip", "trip to England" and "vacation".

Table 1. Number of associations from projected slides.

Number of associations	Number of subjects for each slide					
	1	2	3a	3b	4	5
1	7	2	3	7	16	16
2	5	4	5	10	7	7
3	7	6	9	6	3	4
4	3	5	4	4	1	0
5	1	5	3	0	0	0
6	0	2	1	0	0	0
7	1	1	0	0	0	0
8	1	0	0	0	0	0
m	2.8	3.7	3.1	2.3	1.6	1.6
n	25	25	25	27	27	27

For the slides viewed for 30 seconds (1, 2, 3a) the average number of associations was 3.2, and for the slides viewed for 20 seconds (3b, 4, 5) the average number of associations was 1.8.

Some associations can be looked on as neutral. Examples of this are: "afternoon educational radio", "I turned on the TV too early" (picture 1); "tourism", "boat companies" (picture 3); "Arlanda Airport" (slide 4); and "Dalecarlia" (Dalecarlia is a province in Sweden), "a cabin in the country", and "Skansen" (slide 5) (Skansen is Stockholm's rustic outdoor museum).

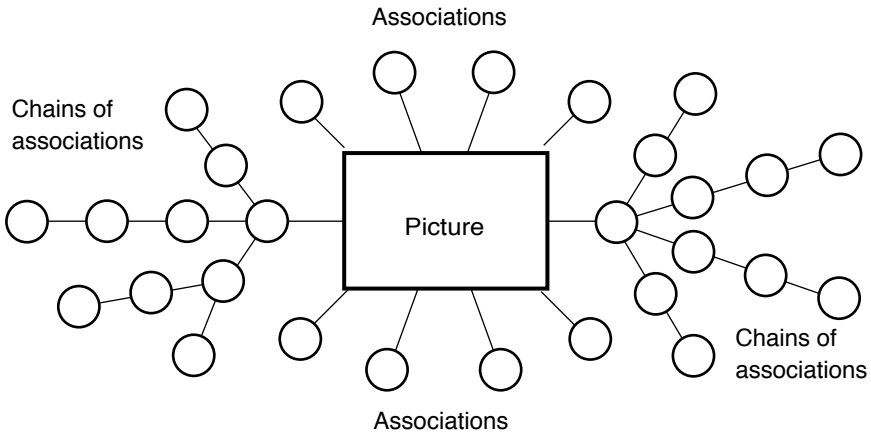

Figure 2. Any picture can arouse a great number of different private associations and chains of associations in different individuals

Clearly, it can be concluded that lecturers and teachers who use slides in their verbal presentations must realize that *pictures can generate a great variety of associations in audiences*. Therefore it is necessary that the presenters talk about pictures in an interesting way, clearly indicating what each picture means to say, so that the message communicated is in fact the intended one.

Russel (1991) has made a somewhat similar study in Australia. She was interested in finding out how individuals make sense of their world through photographs. Children (11 – 12 years old) were given black and white, and color photographs and were asked to write words and phrases which came to mind as they viewed the images. A total of 163 children responded to a picture of five Indian children photographed in a desert environment. The picture elicited more than 400 different words / phrases (associations). On average, a total of 17 words / phrases were given by each child. Russel found that boys used words that are denotative or refer to factual elements in the photograph. Girls used more emotive words, which reflect a viewpoint of the children in the photograph.

Russel concluded that photographs can provide a unique view of life, but the meaning in the mind of the viewer is influenced by the cultural environment and background experiences of the viewer. In making sense of the world through photographs each viewer internalises the message to personal space, time and life experiences.

Russel (1993) described five categories for viewers contributions to photographs. The categories are observation, interpretation, personal memories, participation, and medium intrusion. *Observation*, the photograph is seen as a series of observable elements. *Interpretation*, the photograph is seen as a stimulus for interpretation. The viewer tries to create meaning from the visible elements. *Personal memories*, the photograph is seen as a stimulus to recall personal experiences. *Participation*, the photograph is seen as a stimulus for imaginative participation. The viewer is participating in the scene in the image. *Medium intrusion*, the photograph is seen as a specific communication medium related to the photograper and the camera. These categories for viewers' contributions to photographs can also be found in the Swedish material.

Interpreting pictures in advertisements

Many companies, public authorities, and other organizations put a great deal of effort and money into the design and distribution of advertisements. Sometimes the text and pictures shown are redundant with respect to each other, giving the same information, or at least closely congruent information, to the observer. However, in some advertisements, we see pictures that do not represent the product or service itself, but something altogether different. Thus we

ask ourselves what function these pictures have, and which associations and thoughts they awake in the observer. Are the associations that they bring to mind linked to the advertised product or service? To the company or trade mark? To the "branch" or the entire business as such? Or do they inspire completely different associations?

By way of experiment, I chose at random six advertisements from SCANORAMA, an airline magazine published by SAS, that is meant to be read by passengers on flights and in transit halls. The advertisers are all well-known companies, whose products and services are offered internationally. The advertisements I chose, which were all of full-page format, can be briefly described as follows:

Ad 1
Picture: A black sports car - Toyota - without a driver, seen at an angle from above. The car is close to the road's white line.
Text: Describes the advantages of the product.
Layout: The picture almost covers the upper half of the page. There is a line of text above the picture, and a rather long text below it.
Advertiser: Mobil Oil.
Product: Mobil 1 Fully Synthetic Lubricant.

Ad 2
Picture: A hand gloved in white holding a silver tray with a coffee pot, two cups of coffee, two silver spoons, and two flowers. Black background.
Text: Names various fine restaurants that accept Diners Club Cards.
Layout: The picture almost covers the upper half of the page. The text, white against a black background, takes up the other half of the page. In the lower right-hand corner, inserted into the body of the text, there is a picture of a Diners Club Card.
Advertiser: Diners Club International
Product: Diners Club Card.

Ad 3
Picture: Part of the foredeck, a bit of the mast and the sail of a boat in rough weather.
Text: Tells that the advertiser sponsors the world's toughest sailboat competition, "The Whitbread Round-the-World Race".
Layout: The picture covers about two-thirds of the page. In the lower right corner, inserted into the body of the text, is a picture of an open bottle of Beefeater Dry Gin and a full glass.
Advertiser: Beefeater
Product: Dry gin.

Ad 4
Picture: A man in a pilot's helmet and goggles, with wings strapped to his arms, a suitcase in each hand and a bag that he carries by holding its strap in his mouth.
Text: The airline company SAS has its own hotels in various places, and offers special service for business travelers.
Layout: The picture covers about two-thirds of the page. There is a line of text above the picture. The main text covers the lower third of the page.
Advertiser: SAS International Hotels
Product: Lodging at SAS hotels.

Ad 5
Picture: A Japanese air-hostess, kimono-clad, holding a bowl in her hands.
Text: Tells about the airline's fine service.
Layout: There is text both above and below the picture, which covers a bit more than half the page. In the lower right-hand corner, there is a small picture of a plane partially inserted into the large picture.
Advertiser: All-Nippon Airways, ANA
Product: Air travel.

Ad 6
Picture: The face, throat and shoulders of a young woman.
Text: "Giorgio Armani Parfums", the name of the advertiser.
Layout: The picture covers the whole page. In the lower right-hand corner, a picture of a perfume bottle is inserted. The short text is inside the smaller picture.
Advertiser: Giorgio Armani Parfums. (The name "Armani" is on the perfume bottle.)
Product: Perfume.

The six main pictures were cut out, pasted on white paper and numbered randomly. Two of the pictures (5 and 6) were clipped so that no trade marks could be seen.

In a field study in the spring of 1990, 50 students at Stockholm University took part. The participants were told that the pictures were clipped from advertisements for products made by well-known international companies. They were also told that the advertisements had been published in an airline's magazine, but they were not told the names of either the airline or the magazine. The students got to study each picture for *as long as they needed* – usually a half-minute at the most – to decide what company they thought it represented. Then they were asked to write down the type of product and the company or trade mark that they believed the advertisement was meant to promote. The students were also asked whether they had seen the pictures before.

The results showed that only a few of the students tested had ever seen some pictures before (5 occasions out of 300), and since they were so very few, the material includes them as well. Only a few of the students associated the "right" picture with the "right" product and the "right" company. Four of the six pictures caused all the students to associate them with the "wrong" products. In one case (ad 6), two of the students (4%) associated a picture with the right product, and in another case (ad 5), thirteen students (26%) named the right product. However, only incorrect companies were associated with five of the six pictures. Six students (12%) associated one picture (ad 4) with the right company.

Table 2. Associations from ads.

Advertisment	Product			Company		
	Right	Wrong	Answers	Right	Wrong	Answers
1	0	100	5	0	100	5
2	0	100	6	0	100	15
3	0	100	16	0	100§	14
4	0	100	8	12	88	9
5	26	74	17	0	100	10
6	96	11	0	100	13	

In this table, "right" indicates the percentage of correct answers with regard to the product or the company. "Wrong" indicates the percentage of answers in which the product or company named was incorrect. "Answers" indicates the actual number of different answers regarding products and companies given (not persons who answered) including the alternative "Don't know". The number of subjects were 50.

As shown in table 2, one picture (ad 5) produced 17 different suggestions as to what the product might be. As for companies, another picture (ad 2) elicited 15 different suggestions. Thus it is very obvious that the pictures seldom gave rise to associations that were directly linked to the advertised product or service, or to the advertising company or trade mark. On the other hand, they did produce associations linked to the "branch", or to similar products or operations. Generally speaking, however, the pictures awakened quite disparate associations.

In reaction to the advertisement for "Beefeater Dry Gin" (Ad 3), the product was guessed to be the following 16 products (number of persons in parenteses): Beer (10), spirits (3), sailboats (3), after-shave lotion (3), a soft drink (2), a boat (2), a trip (2), clothing (2), boat accessories (1), whiskey (1), "use a life-preserver" (1), a bank (1), tarpaulins (1), chewing-gum (1), and oil (1). Furthermore, quite

a few students (16) had no idea what the product could be. As for guessing the company or trade mark, the test group came up with several names, but not the right one.

The advertisement for "Georgio Armani Parfums" (ad 6), produced the following eleven suggestions as to what the product could be (number of persons in parentheses): Cosmetics (20), make-up (11), skin lotion (6), beauty products (5), tea (3), clothing (3), perfume (2), hair-care products (2), air journey (1), food (1), and a few subjects (3) had no answer at all. As for guessing the company name or trade mark, here again names were suggested, but not the right one.

It can be concluded then, as in earlier studies (Pettersson, 1985, 1986, 1988, and 1989), that pictures can always be interpreted in a number of different ways. Yet it cannot be said that the pictures in these advertisements were inappropriate to the products they were meant to promote. In the contexts in which they appear, i.e., magazines, billboards, etc., the pictures are shown together with the texts, and *it is the texts that to some degree determine or revise our understanding of the pictures*. It is not very likely that the average observer questions whether a certain picture would suit another product better than the one it advertises. Obviously, the picture's function is not to sell the product in a direct manner, but rather to stimulate the observer's interest in the advertisement as such, thereby enticing him to read the verbal message and thus absorbing information about the product as well as the advertiser.

Conclusions

The first study showed that pictures can generate a great variety of associations in audiences. Thus, it may be concluded that pictures used in information and instructional materials always should have captions to guide the understanding of the content.

The second study showed that pictures can always be interpreted in a number of different ways, and that it is the texts that to some degree determine or revise our understanding of the pictures.

We know from earlier studies (Pettersson, 1985) that, as far as words and pictures are concerned, there is often considerable disparity between the sender's "intended message" and the receiver's "perceived message". Indeed, it is sometimes doubtful whether the receiver has understood anything at all of what the sender wants to convey.

Listeners and readers create their own associations and chains of associations. However, one way of diminishing the gap between the sender's intention with a picture and the receiver's understanding of it, is to present the picture with interesting verbal comments and/or explanatory texts that can actively

"confirm" the intended interpretations (Pettersson, 1993; Melin and Pettersson, 1991).

All the same, it is not sufficient merely to choose good pictures and see to it that they have adequate explanations. To provide readers and listeners with real help in interpreting pictures in AV material, student handbooks and other teaching aids, lecturers and teachers should be given proper guidance, for example, special instruction in pictorial presentation, the aim of which should be to enable them:

- To explain the purpose of each individual picture.
- To supplement the text by telling what the picture shows.
- To give various examples of how each picture can be used in the classroom, i.e., what is important enough to bear discussion? What tasks can be assigned in connection with a given picture?
- To provide, where necessary, supplementary facts about each picture, for example, how the picture was produced.
- To name and discuss the photographer, or artist or other producer of the pictures shown.

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Proposal for a taxonomy

Abstract. *We encounter different kinds of informative messages every day. This document describes a proposal for a taxonomy for informative messages and information material.*

1. Advertising and propaganda

2. Informative entertainment

3. Brief messages
Simple instructions. Prohibitions. Information. Warnings.

4. Administrative documentation
Working materials. Administrative messages. Business documents.

5. Factual information
Facts. Descriptions. Reports.

6. Instructions
Operating instructions. Production and maintenance documentation. Good advice. Interfaces. Recipes. Guidance.

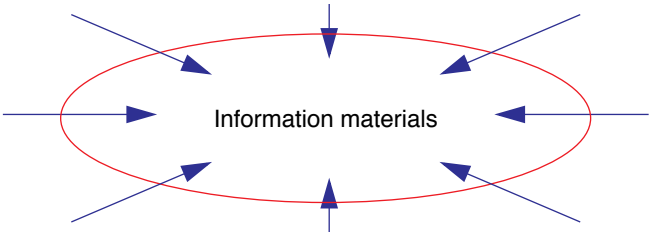
7. Teaching aids

Angles

It is easy to see that a huge array of information materials is available. We can study each individual information document from a number of different perspectives, i.e. 'angles.' The following are examples of angles:

1. Target groups
2. Themes
3. Media
4. Production techniques
5. Modes of presentation
6. Fields
7. Occupational roles
8. Objectives

There may also be other angles meriting consideration. Every angle offers specific aspects of the information material's design and the material's production and distribution. In this process, each angle and each piece of information material might contribute partially new and, possibly, even highly valuable facts for an understanding of the information material's different properties.



Information materials. We should study different kinds of information materials from various angles in order to obtain multifarious information and, therefore, be in a position to develop greater knowledge in the field.

Every angle offers specific aspects of the information material's design and the material's production and distribution. In this process, each angle and each piece of information material might contribute partially new and, possibly, even highly valuable facts for an understanding of the information material's different properties.

Target groups

Target groups are sometimes referred to as users, sometimes as receivers and sometimes as demographical groups. In extreme instances, some target groups only consist of one or two individuals. Other target groups may simultaneously encompass millions of people. Most target groups lie somewhere in between these extremes. The smaller a target group, the greater our ability to describe it in a reasonable fashion. More individual characteristics are manifested in large target groups. Lifestyle is a term often used In advertising to describe groups of receivers on the basis of social and psychological factors. Psychologists and sociologists conduct comprehensive interview studies to elucidate the needs, behaviour, expectations, values and wishes of different groups. The following are examples of some common target groups:

- Different minorities
- Groups of adults
- Groups of children
- Groups of organisations
- Groups of pensioners
- Groups of teenagers, e.g. groupings by school form
- Parents with small children
- People in individual occupational categories
- People with different levels of education
- The amorphous target group 'everybody'

A very large number of different target groups can readily be defined. It is very important to have the clearest and most accurate picture possible of which of all the conceivable target groups senders are striving to reach with each message. The more information we have on a particular target group, the greater our ability to address the intended target group with our message and thereafter be understood. Cf Smith & Ragan (1999) for an extensive discussion of the way different target groups are described!

Themes

In this context, the term 'themes' refers to information material groupings containing some form of conceptual or practical common denominator. A large number of different themes are conceivable for information materials. The following are examples of some important themes:

- Individual sectors, such as trading in raw materials, public health, pharmaceuticals, freight shipments and the transportation of people.
- Information from the authorities, such as information on tax returns, taxation, laws, regulations, local statutes etc.
- Different kinds of information material or media, such as brochures, packaging and manuals.
- Special I events, such as sporting and cultural events.
- Special ideologies, such as political or religious ideologies.
- Special times. They could concern something happening now, something which happened in the past or something which may happen at some point in the future.
- Selected locations, such as in a particular exhibition hall, at an airport, at a railway station or in an urban setting.

Media

Here, 'media' refers to different aids used for transmitting a message from a sender to one or more receivers. Media often encompass very concrete products. The following are the main groups of media (Pettersson 1993):

1. Live media
2. Sound media
3. Film media
4. Broadcast media
5. Video media
6. Models and exhibitions
7. Graphical media
8. Telecommunications media
9. Computer media

Live media are personal communications using speech and body language, i.e. ballet, puppet theatre, group communications with social body language, conferences, churches, live music, pantomime, the school and theatre. In verbal presentations, the spoken word can be combined with body language, demonstrations, stills and even brief sequences employing moving images.

Sound media are CD-DA, gramophone records, cassette tapes, sound archives, tape recordings, audio cassettes and sound cards.

Film media are media projected in some device and viewed on a screen or similar device. Film strips, different kinds of movies, transparencies, microfilm, microfiches, amateur film, overhead pictures, and widescreen films are examples of film media.

Broadcast media are media distributed to groups of people through the 'ether', e.g. national radio, local radio, community radio, cell radio, CB radio, national TV, local TV, community TV and text TV. Mobile telephony also belongs to this category.

Video media provide a high level of information content in a simple-to-understand form. Major examples videotape, videosheet, video discs, and "firm" memory.

Models and exhibitions: In contrast to other media groups, exhibitions are multidimensional. The depth dimension makes it possible to exhibit models and real objects with a spatial relationship to each other and to the public. The use of acoustic media provides some idea of the chronology. Film and video media also contribute movement, distinct processes and courses of events. Lighting, texture, smells and tastes can also be utilised. Many exhibitions offer visitors opportunities to perform their own activities.

Graphical media are made using manual or technical methods. Graphical prints, paintings, signs and drawings are examples of manually produced images. Letters, manuscripts and signs are examples of manually produced text. Evening newspapers, morning newspapers, the popular press and comic books are examples of periodic publications. Children's books, non-fiction, cookbooks, course literature, textbooks, periodic books, reference books, comic books and fiction are examples of books. Different types of packaging belong to the category 'graphical media', as they often have printed pictures and text. The main task of packaging is obviously to enclose and protect the contents. Text and pictures often describe both what packaging contains and how the contents are used.

Tele media are viewphones, datel, datex, Internet, Intranet, voicemail, facsimile, teleconferencing, telephone calls, telegraphy, telepak, 'telesvar' (answering service/ voicemail), teletex, telex, videoconferencing and videotex.

Computer media are fields such as artificial intelligence, expert systems, computer programs and computer games. A 'computer program' is a program in a form enabling it to be processed by a computer. Computer programs may

require transformation, e.g. by compilation, assembly or interpretation of all available data, before being executed by the computer.

Production techniques

Here, 'production techniques' refers to the manner in which different kinds of information materials and information products are produced. Historical aspects and the evolution from rather primitive methods to more advanced production techniques can be studied for most groups of information materials. Production techniques are closely related to media. Production techniques have made rapid advances in recent years. Computers are being used to an ever increasing degree in conjunction with the production of different media. Once data have been stored in digital form, they can be easily presented in a manner tailored to the optimum conditions for different media. The following general trends are discernible for new technology and new media:

1. A shift from goods to services
2. A shift towards increased segmentation
3. A shift towards greater flexibility
4. A new 'distribution of roles', and tradition areas of competence will be broken up and superseded by new ones
5. A shift towards new production systems
6. A shift towards new channels for marketing
7. Increased competition for the individual consumer's time and money
8. The borderlines between different groups of media will gradually disappear
9. Many new media and new technologies will be developed by 'hybridisation'
10. An international, integrated digital telecommunications system will replace today's different systems
11. A common world standard for television will be developed
12. Increased copyright problems.

The term information material refers to the physical representation of a specific information message. Information material is a representation, is intended for a specific target group, is devised in a specific fashion, has a specific purpose and is distributed with the aid of a medium.

Information materials comprise both information products (primary information products) and other types of products with an information content (secondary information products.) The term 'information product' refers to clearly delineated information materials whose primary purpose is to convey infor-

mation. Examples of primary information products are posters, brochures, instruction booklets, instruction programs on video and manuals. Examples of secondary information products are daily newspapers with informative graphics, magazines with recipes, instructions and packaging with declarations of contents, descriptions and instructions. The primary purpose here is always something other than conveying information. Conveying information is a secondary purpose.

Modes of presentation

There is often a considerable discrepancy between the sender's intended message and the message perceived by the receiver, both as regards words and images. It is sometimes doubtful whether receivers perceive anything. Everything usually works better when words, pictures and graphical design are allowed to interact.

Words and pictures can be presented in different ways and with the aid of different media. We can make a distinction between two main groups as regards the presentation of words. We read lexivisual representations and listen to audiovisual representations. Information is only interesting when the receiver has the required basic knowledge enabling her / him to interpret and understand the specific information.

The presentation of all the information available in a field is seldom possible. Normally, information-providers and other writers make a selection. This selection can be more or less subjective. The selection is seldom, or perhaps never, objective. This is difficult or even impossible. You need to have access to all the information to be presented before you can decide on the mix of words and pictures. This decision depends on the most appropriate form of representation in every individual instance. The different media have completely different abilities to convey information. For example, reading texts on a television screen is difficult.

Occupational roles

There are many information professions. Groups which mainly work with information, such as e.g. information providers, journalists, editors and marketers, all have similar knowledge of Man and knowledge of information and communications as starting points. They utilise basically the same methods and techniques in their jobs. However, their roles differ in society. Professional roles give each group a special identity and make different demands on loyalty, experience and know-how. The loyalty of an information-provider is to his employer. The loyalty of a journalist should be to her / his readers, listeners and viewers

rather than to her / his employer. Examples of occupational roles related to information and information material are:

- Archivist
- Book editor
- Chief editor
- Computer typographer
- Consultants
- Design assistant
- Designer
- Desktop publisher
- Dictionary editor
- Documentalist
- Draughtsman
- Editor
- Editor of cultural pages
- Editor-in-chief
- Exhibition producer
- Expert
- Foreign editor
- Gate-keeper
- Graphical artist
- Graphical planner
- Illustrator
- Infomaster
- Informatic
- Information broker
- nformation designer
- Information manager
- Information secretary
- Information stage designer
- Information-provider
- Journalist
- Librarian
- Linguist
- Map editor
- Marketer
- Night editor
- Non-fiction writer
- Photographer
- Picture editor
- Press secretary
- Producer
- Social information-provider
- Teacher
- Technical information-provider
- Technical writer
- Translator
- Typographer
- Webmaster

An information designer is to a large extent a project manager who coordinates work on text, images and graphical design.

Fields

In this context, 'fields' refers to clearly delineated activities, often addressing specific target groups, in which access to a certain type of information is important. The following are examples of some important (subject) fields

- Administrative information
- Consumer information
- Economic information
- Geographical information
- Product information
- Public health and pharmaceutical information
- Social information
- Technical information
- Tourist information.

We could obviously mention even more fields in which information materials may be important. Different kinds of information products and, accordingly, different media can be used in each field.

Objectives

In this text, the term objectives refers to what the sender wishes to achieve with her/his message, i.e. the goal(s) the sender wishes to attain. The objective of information material is usually linked to some utilitarian aspect in which the receiver is supposed to understand how something works or how she or he should behave in a given situation in order to avoid or resolve a problem.

Good information material has a distinct structure, it is relevant, legible and readable by the intended target group. Good information materials meet stringent demands on good economics, good contents and good linguistic and technical quality. Different information materials may have multiple functions and more than one objective all at the same time. As a result of the aforementioned properties and demands, good information materials make everyday life simpler for receivers who need the specific information and provide senders with a good economic return and good credibility. With the main objectives as the starting point, seven distinct groups of information materials are discernible. Differences between information materials are considerable, or even very considerable, within each group. There are usually clear and distinct differences between the seven groups. The seven groups are:

1. Advertising and propaganda

2. Informative entertainment

3. Brief messages

1. Simple instructions
2. Prohibitions
3. Information
4. Warnings

4. Administrative documentation

1. Working materials
2. Administrative messages
3. Business documents

5. Factual information

1. Facts
2. Descriptions

3. Reports

6. Instructions

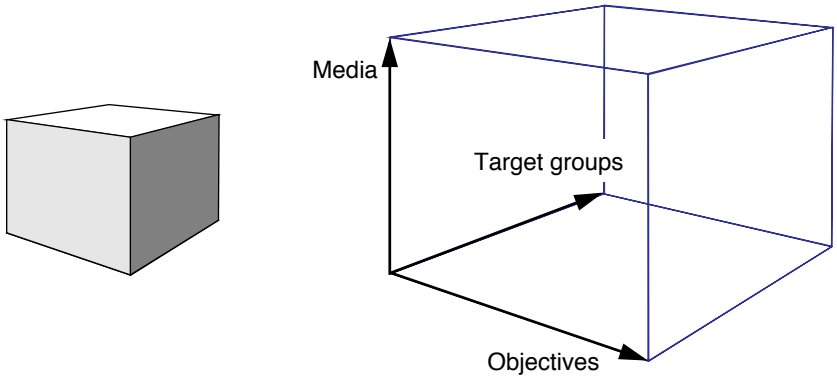
1. Operating instructions
2. Production and maintenance documentation
3. Good advice
4. Interfaces
5. Recipes
6. Guidance

7. Teaching aids

This classification is based on the main objectives for information materials. However, some information materials simultaneously contain more than one kind of information message. Packaging may contain e.g. both factual information and one or more instructions. Packaging etc. could well be assigned to a category with 'combined objectives.'

Model

Information materials can be structured in a three-dimensional model, i.e. an information box, for each subject field. This box describes the relationship between objectives (x), media (y) and target groups (z). A number of such boxes can be devised. There is one box for technical information-providers, one for the information-provider disseminating social information or tourist information etc.



The information box is one way to describe the relationships between objectives, media and target groups in each field in which information material is needed.

Each box covers hundreds of conceivable types of information materials, all with specific subject content. A number of examples of information materials a professional information designer might be asked to produce are supplied on the following pages. Here, the information materials are arrayed into the seven groups with main purposes, according to increasing cognitive and mental demands made on receivers in the different target groups. Some groups comprise more than one type. There are usually a large number of individual examples in each type of information material.

The term 'text' when used in descriptions of the seven groups of information materials refers to words, pictures and shapes. So the concept 'informative texts' refers to the sum of (1) informative words, (2) informative pictures and (3) informative graphical shapes. This total is sometimes referred to as discourse (Nordström, 1996). In some instances, different kinds of sound, music, movement, spatial rendition, special lighting or various effects are also involved.

Advertising and propaganda

Certain kinds of advertising and propaganda can be included in the concept information material, broadly interpreted. As regards advertising and propaganda, the idea is for the receiver to imitate, emulate or mimic, i.e. to intentionally try to resemble someone else, become convinced of something, behave in a particular way, adopt a particular attitude or buy a product or an idea. We can use the following in achieving these objectives:

- Advertising texts
- Agitation
- Persuasive texts
- Propaganda texts
- Rhetoric

We can make a distinction between two groups of advertising and propaganda: (1) advertising and (2) propaganda.

Advertising

The objective of advertising is to sell products and services. This group of information materials works mainly with persuasion, as well as marketing. Advertising and propaganda can resemble both infotainment and factual information. This applies e.g. to TV commercials.

Propaganda

The objective of propaganda is to disseminate an idea, an opinion or a philosophy. Propaganda often reinforces our prejudices in a negative or positive fash-

ion. One of the reasons why pictures and imaging media have such importance in advertising and propaganda is because they directly appeal to our emotions. Pictures are seldom scrutinised as critically as texts.

Media for advertising and propaganda

Films, graphical media (such as posters, brochures, labels, packaging and newspapers), radio, TV, video and the WWW are examples of media for advertising and propaganda. TV advertising has undergone an explosive economic development in Sweden in recent years. Advertisers are investing increasing amounts of money in TV advertising. But according to a study conducted by the National Swedish Board for Consumer Policies (1993), Swedish TV viewers are critical of TV commercials. Only one out of ten (11%) people felt that TV advertising supplies correct information about goods and services.

We seldom, or never, expect advertising and propaganda materials to be completely objective and unbiased. We should always try to retain some preparedness for interpreting these messages. However, both advertising and propaganda messages are often promulgated in a highly insidious fashion. Pictures can often have a subconscious impact on people's emotions. Content is then never critically analysed nor processed. It may sometimes be very difficult for people to shield themselves against advertising and propaganda messages, especially when the messages are frequently repeated. A definite 'attrition effect' occurs. If a message is repeated often enough, we may lose our ability to be critical and analytical about it.

Many culturally and historically interesting messages, such as paintings in medieval churches and the design of church buildings, castles and manor houses, can be included in this category of information materials. Art and lavish buildings currently convey a clear message about power and influence.

Informative entertainment

Several types of materials designed to entertain can be included in any interpretation of the concept 'information material' (infotainment). The material should enable the reader to relax, obtain recreation, pleasure and enjoyment for the moment without making any major demands on her/his mental activity to achieve a deeper understanding. The following can be used for obtaining these objectives:

- Fireworks
- Interviews
- Light shows
- Literary texts
- Narrative texts
- Poetry
- Prose
- Reportage texts

Information fields

This group of information materials operates mainly in media design, journalism and, to some extent, even information design. We can easily comprehend fragments of individual events from around the world because television is a suitable choice for supplying fragments out of context, often without any real value. According to Postman (1985), television in the U.S. has made entertainment the natural form for all presentations of reality. Postman wrote (p. 95): "The problem is not that TV supplies us with entertainment but that all subjects are supplied as entertainment." In my view, a news program in North American TV is a kind of entertainment rather than a source of factual information. News programs in Europe are usually more factual information than entertainment. However, TV news broadcasts in Japan appear to me to have features clearly suggestive of popular education

Media for informative entertainment

Examples of common media for infotainment are motion pictures, graphical media (such as books and magazines), radio, TV and video. We anticipate increasingly rapid development of infotainment on the Internet and WW.

Brief messages

Information materials and information messages in the Brief Messages category have two objectives. The receiver shall notice, i.e. direct her/his attention to, certain information, then perceive, i.e. become aware of, something and heed and respect e.g. bans and warnings. We can use the following in achieving these objectives:

A message is information conveyed from a sender to a receiver in a single context on one occasion. A message is usually brief and clearly delineated in the form of a signal, i.e. transmitted characters with a mutually agreed meaning. This category of information materials is found both in persuasion design (especially in planned communications) and in information design. We can easily make a distinction between four kinds of brief messages: (1) Simple instructions, (2) Prohibitions, (3) Information and (4) Warnings.

- Acoustic signals
- Body language
- Combined acoustic and optical signals
- Emergency signals
- Graphical symbols
- Instrument panels
- Instrument windows
- Olfactory signals
- Optical signals
- Planning boards
- Prohibition texts
- Prose
- Sensory signals
- Signal lamps
- Signal texts
- Symbols
- Warning texts.

Simple instructions

An instruction is explanatory information on an appropriate procedure in a given situation. Short, distinct instructions are involved. The instructions may be impressed or printed on different products, such as doors, signs and radios, in the form of words, letters or symbols. Distinguishing between 'push' and 'pull' may be appropriate when we open a door. In traffic, for example, many road signs provide instructions on how people should drive in different situations.

Instructions can also be conveyed with systems of signals and characters. This may be the case e.g. when an umpire gives orders to players in a football match or when ground staff instructs a pilot in a taxiing aircraft about the right gate, enabling passengers to disembark and making space for new travellers to go on board.

Prohibitions

A prohibition is a regulation stipulating something which must not occur or be done, often because of the risk of injury to people or property damage. A prohibition may be impressed or printed on different products, such as machinery, signs and fences, in the form of words, letters or symbols. Trespassing on private property, diving from a trampoline, entering a construction site, camping, various activities in traffic etc. are examples of prohibitions.

Information

Here, information refers to a brief message intended to be of direct, practical benefit to the receiver. Information can be impressed or printed on different products, such as machinery and signs, in the form of words, letters or symbols. Much useful information is supplied in traffic, e.g. on route signs. Other exam-

ples of information are emergency signals, such as flares or signal rockets from ships in distress or hikers who get lost or injured.

Warnings

A warning refers to the designation of a possible hazard which can be avoided by caution and responsible behaviour. Like other instructions, prohibitions and information, warnings can also be impressed or printed on different products, such as machinery in the form of words, letters or symbols designating e.g. an electrical safety hazard or high voltage. Warnings on signs may concern warnings for shallow water or thin ice, warnings to car drivers, pilots, locomotive drivers and machinery operators etc. Warnings of different kinds are often printed on packaging, such as warnings for hazardous substances and warnings on the use of certain drugs in conjunction with driving (as they would make drivers less attentive in traffic). Warnings can be conveyed with acoustic signals, e.g. fire alarms and fire-drill warnings. Warnings may also be issued in weather forecasts, e.g. warnings for icy roads, hail, storms or, at worst, a tornado, things we would rather avoid.

Media for brief messages

Today, graphical media, such as brochures, packaging and catalogues, signs, warning flags, signal systems and warning triangles, are examples of media commonly used for warnings and prohibitions. We can use our own bodies, body language and gestures to convey distinct messages to other people, not the least when warnings and invitations are involved. However, the signals need to be interpreted in the right way.

Administrative documentation

We need administrative documentation in many situations in our professional and private lives. Having your paperwork in order is important in contacts with banks, insurance companies, public health units, public agencies and even many organisations. Good administrative documentation and reliable routines create good conditions for satisfactory operation of various activities. The following information components can be used in maintaining functional administrative documentation:

In both graphical design and information design, people often work with ‘templates’ for administrative documentation. Ready-to-use templates save considerable time and contribute to the creation of a distinct and uniform structure for documentation and to a uniform identity for an organisation. Each

- A standardized layout for all kinds of administrative documentation in an organisation, i.e. 'graphical templates"
- A system for numbering documents
- A system for numbering versions
- Addresses
- Bank giro account numbers
- Dates
- Logotypes
- Postal giro account numbers
- Prose
- Tables

organisation needs a carefully thought-out programme for its graphical profile. Many organisations utilize a set of governing 'profile rules'. It must be easy for an organisation's own employees, as well as external receivers, to find relevant information in each administrative document. This involves the organisation's name and logo and other administrative information, such as the address, number of pages, the date, the type of document, the author, the approving party, the examiner, the version, the degree of confidentiality and the subject.

Working materials

Commonplace objectives may be to work with information by revising, processing and structuring different data. Finding suitable forms for distributing certain information may be important. Examples of common types of working materials are:

- Forms/blanks
- Lists (of various kinds)
- Memos
- Minutes
- Notes (taken at meetings)
- Tables

Administrative messages

Some of the objectives of administrative documentation are to show how to deal with various processes and issues, i.e. to explain, inform, report and describe. Examples of common types of administrative messages are:

- Agendas (for meetings)
- Calendars
- Directives (on work tasks)
- Distribution lists
- Electronic mail
- Fax messages
- Letters
- Lists (of various kinds)
- Lists of appendices
- Lists of documents
- Memos
- Minutes
- Summonses to meetings
- Tables

Business documents

Administrative documents are important for documenting, filing, storing and saving information on events, prices, processes and products. We can also use administrative documentation for monitoring, controlling and verifying various processes and products. Quality assurance, for example, always generates a great need for continuous:

- Contracts
- Cover notes
- Fax messages
- Forms/blanks
- Invoices
- Letters
- Memos
- Minutes
- Receipts
- Tables

Many contemporary business documents have their roots in the medieval bookkeeping conducted by churches and monasteries. We can learn a great deal by studying administrative routines in different organisations. Very important changes in administration took place in Sweden from 1500 to 1720. Svensson (1988) states that control and information were then the predominant functions of all communications. The spoken language was still the predominant form, but written and printed texts ultimately began to make their influence felt

Media for administrative documentation

Graphical media are still most common, but electronic mail and storage in databases are becoming increasingly popular for administrative documentation. The need for carefully thought out typography and layouts is even greater in computer media than in traditional graphical media. This is mainly because of the major limitations still prevailing in the resolution of computer screens.

Swedish archival capacity is inadequate. Growth in the public sector alone amounts to 40,000 shelf-metres a year. The National Archives, the Military Archives, the provincial archives, the Municipal Archives in Stockholm and Malmö and the Audiovisual Archives are Sweden's archival authorities.

As early as 1983, three Japanese electronics companies, Toshiba, Sony and Matsushita, introduced optical discs for recording, storing and displaying documents, such as letters, articles etc., with both text and pictures. Various forms of digital information storage can contribute to a solution of the archival capacity problem. One small optical disc is capable of storing thousands of pages of text.

Factual information

Supplying information is by far the most common of all perceived objectives. This is the primary task of a large number of information materials, such as posters, descriptions, brochures, instruction booklets, information sheets, handbooks, web sites for the WWW, informative graphics, information systems, maps, catalogues, route signs, reports, schematic drawings, signs, symbols and certain exhibitions. We can use some of the information components below in developing the kind of information material listed on the next page.

The group could conceivably even be referred to as 'facts' or just 'information', but this would be needlessly confusing, as the term 'information' is used in so many different contexts and in so many different ways. Factual information is always more comprehensive than brief, simple messages. This category of information materials is usually produced in the field of information design. The group is both very broad and very deep, i.e. many different examples of information material of the same type are found. This type of information is very commonplace. Information material in the factual information category can impinge on the advertising and propaganda group.

- Addresses
- Article numbers
- Bank giro account numbers
- Bar codes
- Dates
- Declarations of contents
- Delivery terms
- Descriptive texts
- Drawings
- Indices of various kinds
- Informative graphics
- Informative texts
- Informative texts
- ISBN numbers
- ISSN numbers
- Lists of various kinds
- Maps and plans
- Narrative texts
- Non-fiction texts
- Postal giro account numbers
- Price information
- Product numbers
- Prose
- Registration numbers
- Schematic pictures, diagrams and graphs
- Serial numbers
- Subject indices
- Summaries
- Symbols
- Tables

We can make a distinction between three types of factual information: (1) facts, (2) descriptions and (3) reports.

Facts

The objective of facts is for the receiver to comprehend, i.e. to succeed in understanding the meaning of something and possibly, but not invariably, forming

her/his own opinion about it. Examples of information areas or themes for facts are:

- Information on current events, historical events, future events.
- Information on geographical location; where something is, the best route to get there.
- Information on goods and services, prices, dimensions, delivery times, delivery terms, performance etc.
- Information on organisations, their addresses, bank giro account number, managers, complete names, legal status, postal giro account number, business hours etc.
- Information on times. What time does the bus, ship, flight, train depart? What time does the show begin? How much time do I have left on the parking meter?
- Safety information, e.g. evacuation from a ship, aircraft, hotel. public building etc. in the event of a fire or other hazard.

Descriptions

The purpose of descriptions is to enable the user to comprehend, i.e. understand, certain information with respect to its immediate or basic meaning. Descriptions are different kinds of materials which depict what something looks like or how it works. Examples of information fields or themes for descriptions are:

- Anatomical descriptions
- Biological descriptions
- Company descriptions
- Consequence descriptions
- Construction descriptions
- Ecological descriptions
- Economic descriptions
- Event descriptions
- Historical descriptions
- Job descriptions
- Medical descriptions
- Physiological descriptions
- Process descriptions: courses of events and processes
- Product descriptions: goods and services
- System descriptions
- Technical descriptions

Descriptions can sometimes be related to facts, reports and instructions.

Reports

The purpose of reports is often to help the receiver understand, i.e. to absorb conceptual concepts in reports and form an understanding. Understanding more or less complex relationships, comparing different alternatives with one another and reaching her/his own conclusions about the way to act in other

situations are examples of what is involved. Reports are formal accounts of studies and completed assignments. Examples in the information field or themes for reports are:

- Conference reports
- Final reports
- Financial reports, such as final accounts, forecasts, annual reports etc.
- Inspection reports
- Interim reports
- Position reports
- Reports issued by experts
- Scientific reports
- Technical reports
- Test reports
- Traffic reports
- Weather reports.

Reports can be closely related to descriptions.

Media for factual information

Factual information is presented in all media, even if graphical media, such as brochures, posters, fact sheets, non-fiction books, handbills, packaging, handbooks, booklets, product sheets, information sheets, maps, catalogues, product sheets, signs, tables, magazines and reference books, are still most common. However, the amount of information in different databases, on various kinds of optical discs, on the Internet and various intranets is increasing at a rapid rate. Information systems vary greatly in complexity and scope. Examples of 'simple information systems' are systems for indicating arrival and departure times for buses, ships, flights and trains. These systems can be analogue or digital. Examples of more advanced systems are digital map and positioning or navigation systems, 'information towers' with stacks of video discs and databases etc. Cave art, petroglyphs, rune stones, picture stones and some of our church paintings are examples of historically interesting messages in this category.

Instructions

Instructions are directions and explanatory information on appropriate procedures for achieving specific results in a safe and reliable manner. This category of information materials differs from the Brief Messages group, which comprises simple instructions, prohibitions, information and warnings, by demanding more comprehensive action in multiple stages. The purpose of instructions and directions is to enable the user to perform some concrete task. We can use the following in achieving this purpose:

- Directions
- Drawings
- Explanatory texts
- Instructive texts
- Prose
- Prose
- Subject indices
- Symbols

The text "Push" on a door is a brief message. The simple text "In an emergency / turn the handle / open the door / manually" in a train is an instruction, as it comprises multiple stages (/ designates line breaks). Instructions sometimes place special emphasis on practice and learning. However, all you need to do is follow the instructions in directions for use, manuals or user handbooks on one or a few occasions. Instructions may be closely related to descriptions. People work with this category of information materials mainly in information design. We can make a distinction between six groups of instructions: (1) Directions for use, (2) Production and maintenance documentation, (3) Good advice, (4) Interfaces, (5) Recipes and (6) Guidance.

Directions for use

Directions for use are written instructions explaining what someone has to do in order to use some device etc. This especially applies to instruments, machinery and tools. The people who will be using the product in question are the target group for directions for use. Directions for use are often in the form of printed sheets or booklets as well as in digital media. Users often need the instructions in directions for use just to 'get started'. Once a TV set and a VCR have been installed, using these products seldom presents any problem. 'Incorporating' directions for use into technical systems is becoming increasingly common. Necessary information can then be viewed on a monitor. Since information cannot be accessed in the event of a power failure, we will still need to have some information in graphical media in the future.

Production and maintenance documentation

We are accustomed to turning in our cars for periodic servicing. This also applies to many other products. Instructions for production and maintenance must be prepared for every new car model, ship, computer system, aircraft, nuclear power plant, motorcycle, chain saw, paper-making machinery, telecommunications system, train, video camera and many other types of products. Some of these instructions are intended for people making routine use of the products. Other documentation, e.g. with instructions on how to perform certain functional tests, how to trace and find faults, how to replace or repair defective parts etc. so equipment operates reliably, is intended for specially trained service technicians. Production and maintenance documentation is often collected in bind-

ers but is also in the form of instruction films and databases accessible on CD or the internet.

Good advice

'Good advice' provides a simple explanation of how to perform various practical tasks. Newspapers, magazines and some TV programs offer good advice. They give us e.g. tips on how to arrange flowers, how to diet, how to build furniture and how to use makeup according to the latest fashion trends.

Interfaces

Many products have fixed interfaces in e.g. instruments and instrument panels. One example is the instrument panel in a car. The instruments consist of e.g. a speedometer, fuel gauge, thermometer, clock and tachometer. Words or simple characters or symbols are impressed or printed on the product. They can be printed on labels or signs. Some messages from a fixed interface are brief messages, whereas others comprise instructions requiring action in several stages. Fixed interfaces are gradually being superseded by graphical interfaces in many products. Graphical interfaces differ from fixed interfaces by tailoring information to different situations and e.g. only displaying information important for the moment. Graphical interfaces can supply instructions on when, where and how the user or operator should enter data in different computer systems and certain equipment, e.g. in process industries to ensure that equipment operates in a satisfactory and safe fashion. Instructions on the way the graphical interface operates are usually referred to as manuals which are actually the same as directions for use.

Recipes

An increasing number of raw materials and semi-manufactured products are supplied with information on the contents inside packaging and ways to prepare those contents. This obviously applies to directions on preparing various dishes but also includes different kinds of chemical products, such as commercial fertiliser and insecticides, Recipes and instructions on how to prepare food are frequent features in weeklies, cook books and TV shows.

Guidance

'Guidance' provides assistance and uses detailed written instructions to explain how to behave in a general, professional and appropriate manner e.g. in solving a problem or performing certain tasks. A handbook provides broad, sum-

marised information on subjects, often practical in nature. It may deal with e.g. the art of angling, riding, painting, growing flowers, collecting stamps, bird watching in the field, drawing etc. Guidance in brochures and handbooks may be more than superficial. You often need to return repeatedly to guidance.

Media for instructions

Several examples of media appropriate for instructions were noted in conjunction with the aforementioned accounts.

Teaching aids

The objective of 'teaching aids' is for the receiver to learn an intended subject, i.e. acquire new knowledge and new experience. In time, the receiver may become familiar with the subject, gain insight and learning and, ultimately, knowledge in one or more subjects. We can use the following for achieving these objectives:

- Argumentative textsDescriptive texts
- Discussion texts
- Explanatory texts
- Indices
- Indices of subjects
- Instructive texts
- ISBN numbers
- ISSN numbers
- Prose
- Summaries

Teaching aids are pedagogic adjuncts for direct use in training, instruction and education. The following are examples of products:

- Non-fiction books
- Practice materials.
- Reference books
- Teacher's manuals
- Textbooks

Information fields

The following are examples of information fields or themes for teaching aids:

- Subjects in compulsory education
- Other subjects

In this category of information materials, people work in information design and instruction design.

Media for teaching aids

A-V media, graphical media, such as textbooks and reference books, radio, TV, video and different kinds of databases, are examples of common media.

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Circles, triangles and squares

Abstract. *The circle and the triangle, as well as the square, are shapes that have been natural to man for a very long time. There have always been circles and triangles in our natural environment, and they have already been used as important symbols in pre-historic cultures. This paper presents the use of circles, triangles and squares as sacred symbols in the old Mayan civilization. The paper also presents one of the oldest forms of mediated communication through moving images, the "moving picture" in Chichén Itzá, Mexico.*

Symbols

Symbols are signs representing objects or ideas. In specific areas symbols are a supplement to all languages to help create better and faster understanding. Today symbols have evolved to the point of universal acceptance in such areas as music, mathematics, and many branches of science. Taking up only a very small amount of space, symbols can convey a message containing a large amount of varying information, equivalent to one or more sentences of text. Image perception is very rapid, virtually "instantaneous". Reading and comprehending the equivalent message in words takes much more time. So symbols permit rapid reading. This is important in numerous situations, e.g., in traffic, industry, and aviation.

Some figurative graphic symbols are *pictorial* and representational (Pettersson, 1993). They are "image related" and simplified pictures. Pictorial symbols resemble the objects they represent. They can be characterized as silhouettes or profiles with no surface detail. An old traffic sign with a silhouette of a locomotive, to denote a railroad crossing, is an example of a pictorial symbol.

In the design process, some pictorial symbols may be successively simplified into figurative and *abstract* graphic symbols (op. cit.). They still look like the objects they represent but have less detail than pictorial symbols. In athletic contests, like the olympic games, abstract graphic symbols are often used to denote the different kinds of sports. Good abstract graphic symbols are intuitive. We should be able to understand their meaning.

Some figurative symbols are *arbitrary* graphic symbols (op. cit.). They are invented and constructed from the designer's imagination. Usually arbitrary

graphic symbols have no resemblance at all to the objects or to the ideas that they represent. Many are based on geometric shapes. Many signposts and traffic signs are often good examples of arbitrary symbols. They are unambiguous by convention; we agree and decide on their meanings. Just as new words have to be learned when we begin to study a new topic, we have to learn arbitrary graphic symbols.

Many non-figurative *verbal symbols*, written characters, and letters of various alphabets have evolved from simplified pictures (op. cit.). Verbal symbols are used in written languages and in many branches of science. In many areas, verbal symbols have reached universal acceptance.

When small children scribble they make dots, lines, and endless open circular movements (Kellog, 1955). Already at the age of three children may draw solid circles, triangles and squares (Berefelt, 1977). In my view, we perceive circles, triangles and squares at a low cognitive level without any special analysis (Pettersson, 1989). Due to their simplicity, circles, triangles and squares are often used as icons or symbols in modern verbo-visual communication, and as picture elements in schematic pictures. However, this simplicity also means that these simple shapes can be perceived in many ways by different people. Functional, instructive graphic symbols are probably older than words, and they are probably found in every culture however primitive. From the following example, the old Maya civilization, we can see that it is possible to trace a meaningful use of basic geometric shapes as symbols far back in time and history. Circles, triangles and squares were important for the Mayans, and they were probably also important in many other prehistoric cultures.

The Maya civilization

The first humans who came to North America where tribes of nomadic hunter-gatherers from Siberia. They followed the big game over the land connection between Asia and Alaska. This was some 30,000 – 40,000 years ago (Coe et al.,1986; Stora Focus, 1987–1989). These groups of people gradually moved south without further contacts with the old world. Already 5,000 – 6,000 years ago people began to grow maize (or corn) in different places in Mesoamerica, a region stretching from northern central Mexico to Costa Rica in Central America (Harrell, 1994). Cultivation of maize was a prerequisite for groups of people and tribes to settle down into farming villages, and thus also a prerequisite for the later high civilizations in Mesoamerica.

Already more than 3,000 years ago the Maya Indians spoke dialects of the Mayan language in the highlands of Guatemala and Belize (Blacker, 1965; Salmoral, 1990). Maya traders had the advantage of a common language. The oldest Mayan ceramics and pottery, dated at 2,500 B.C., has been found in Belize

(Brunius, 1992). Early Mayas were settled. They grew maize, beans and root vegetables on burn-beaten lands and they developed remarkable cultures. At its first height, the "Classic Period", from the A.D. 250's to the 900's (Harrell, 1994), this society may have included about two million people (The World Book Encyclopedia, 1963).

The Maya lived in isolated and independent city-states in dense forests in present-day Guatemala, El Salvador and Honduras, as well as in present-day Belize (Coe et al.,1986). For some unknown reason, the Maya civilization declined within these areas. The Mayas moved north to low lands in south eastern Mexico, especially to the Yucatán peninsula. Here the Maya civilization had a second height for a period of 300 years, from the A.D. 600's to the 900's, before it started to degenerate (Harrell, 1994). Never-ceasing fights and civil wars among the city-states in the Yucatán peninsula weakened the strength of the Mayas and destroyed the highly cultivated society and the conditions for prosperity. According to Vidal-Naquet (1987) the society collapsed from within.

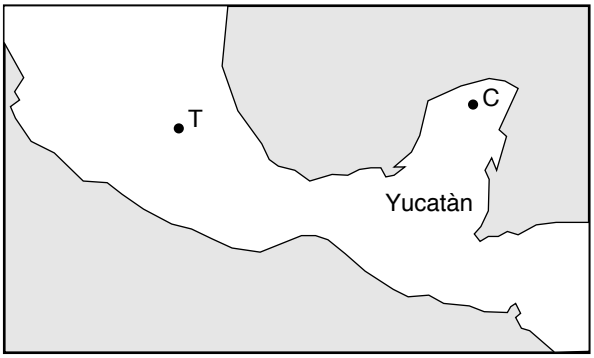

Figure 1. Schematic map showing the approximate locations of Tula (T) and Chichén Itza (C).

The Mesoamerican Indian civilizations, Olmec, Toltec, Mayan, and the other high cultures culminated in the Aztec empire. When the Spaniards invaded Mexico at the beginning of the sixteenth century, the Aztecs ruled over 20 million subjects. The empire opened on to two oceans, controlling the trade routes through Central America (Vidal-Naquet, 1987). The ruling dynasty had only been in power for 150 years. The Aztec regime had invented and introduced a new religion, which included holy wars and holy human sacrifice. This united the priesthood and the army and had served as the cornerstones in an aggressive expansion policy.

It was this empire which Cortes conquered with the aid of 600 soldiers, sixteen horses, ten cannons and thirteen arqueuses. The Aztecs revered Cortes as a "god of light". He was considered to be the bearded and sacred white man

which they had been waiting for (Dineen, 1992). The Spanish conquerors destroyed as much as they could of the cultures in Mesoamerica (Blacker, 1965). Only ten years after the first fights (1519) Mexico was captured. The invaders brought diseases like smallpox, measles, and typhus. The original populations had no resistance to these new diseases. More people died from diseases than from the cruel treatment from the Spaniards. However, in some places the local resistance was strong. The last Maya city, Tayasal, did not surrender until 1697 (Harrell, 1994).

Temple cities

Ancient Maya achievements include superb art and architecture, a highly developed style of hieroglyphic writing and of mathematics, and a precision in tracking time day by day over centuries. Hundreds of Maya cities were centers for religious festivals, markets, and courts of justice (The World Book Encyclopedia, 1963). These temple cities are spread throughout south-eastern Mexico and Guatemala. They are also believed to have served a function similar to universities of today. Each major Maya city was carefully planned with monumental and remarkable buildings of stone, such as temple-topped pyramids and palaces in the center, astronomical observatories, dwells, aqueducts, and decorated stone pillars, a nearby ball court for the famous pre-Hispanic team sport (Ventura and Ceserini, 1982).

During the religious ceremonies the priests lived in the ceremonial center of the town. The priests and the nobility had embroided or painted clothings made of cotton and decorated with feathers. Common people had clothes of pounded tree bark or sisal hamp. Many had necklaces of seeds or beetle wings. The common people lived throughout the countryside in simple huts made of poles, mud, grass and palm leaves. They grew maize, beans, squash, chili peppers, avocado, sweet potatoes, papaya and some other crops. Stone-surfaced roads connected cities and parts of cities. This was at a time when their European counterparts were largely dependent on dirt tracks. Some of the most important Mayan cities are Bonampák, Chichén Itzá, Copán, Labná, Palenque, Piedras Negras, Tikal and Uxmal (Coe et al.,1986).

The Mayan architects built their pyramids, temples, and observatories with cores of dirt which they covered with facings of limestone. One of the Maya's unique contributions to architecture is the Korbal Arch, also called the Maya Arch. This was formed by projecting stone blocks out from each side of a wall until they met forming a peak. This technique was a good substitute for a true arch (Coe et al.,1986; Stora Focus, 1987–1989). Some of these almost "solid" buildings have lasted for hundreds of years. Since they had no wheeled vehicles, people had to carry all the building materials.

Decorated stone pillars, reliefs and mural paintings tell us about the daily life of the Mayas. Extraordinary mural paintings were discovered in a small temple in Bonampák in Mexico in connection with a movie production in the 1940s. The pictures show musicians playing drums, trumpets and maracas (Salmoral, 1990). Unfortunately the colors started to fade in contact with the air outside the temple.

Maya traders came to the markets in the cities. They had developed complicated networks in the southern parts of Mexico and in the northern parts of Central America (Dineen, 1992). Local farmers brought maize, beans, squash, chili peppers, avocado, sweet potatoes, papaya and honey. People of the lowlands traded jaguar pelts, feathers, copal incense, lime, flint knives, and edible hearts of palm trees. In return, they received the highly prized quetzal feathers and jade of the highlands, and sharp obsidian, or volcanic glass, which was used for knives.

After the Spanish invasion the temple cities were forgotten for centuries. They were covered by trees and other plants. During an expedition 1839–1840 the American lawyer John Stephens and the British artist Frederick Catherwood discovered the three cities Copán, Palenque and Uxmal. Their findings became a sensation, of the same order as the first expedition to the moon in our time. It is quite possible that people will discover temple cities still unknown in the vast jungles in Mesoamerica.

Calculation of time

Science was in the hands of the Mayan priesthood. Priests were very good at astronomy and mathematics (Ventura and Ceserini, 1982; Harrell, 1994). The astronomers developed systems for accurate calculation of time. Every division of time was "lucky" or "unlucky", and was ruled by a separate god. The priests made calendres and tables of dates on which to prepare religious ceremonies and daily life. The year of the sun, *tun*, had 365 days and was divided in 18 periods of 20 days. In addition there was an "unlucky" period of five days without ruling by any god. Many evil things could happen during these five days. The other calendre was a sacred year comprising of 260 days and divided into 13 periods of 20 days. The Mayans believed that history would repeat itself in cycles of 260 years.

In contrast to other high civilizations the Mayas created a system of numbering which included a symbol roughly equivalent to our zero, although it really stood for completion (The World Book Encyclopedia, 1963). Therefore it was possible for astronomers and mathematicians to make calculations with large numbers. The Mayan system of numbering was *vigesimal* and based on the number 20 (the number of fingers and toes) instead of ten, as in our numbering system. Numbers one to four are written with dots. Number five is a

dash. Zero is a symbol for a shell of a clam. Vertical positions of the three symbols denominate their values. Numbers on the baseline (kin) are multiplied by one. Numbers in the second position (uinal) are multiplied by 20, numbers in the third position (tun) are multiplied by 360, numbers in the fourth position (katun) are multiplied by 7,200, and finally numbers in the fifth position (baktun) are multiplied by 144,000.

The Maya had a more advanced type of writing than any other Indian group. Their symbols stood partly for sounds and partly for ideas. It was a kind of hieroglyphic writing. One glyph may stand for a word. Only fragments of the rich literature are preserved. Archeologists, linguists and other researchers are still trying to understand the hieroglyphic writing of the Mayas. Much of this work is done in archives in Spain, Guatemala and Mexico.

Religious ceremonies

The Spanish monk and bishop Diego de Landa arrived in Mexico a few years after the conquest. Through his careful notes and through his letters to the Spanish king researchers today know a lot of the religious lives of the Aztecs, the Toltecs and the Mayas, and especially about their special religious sacrifice ceremonies (Salmoral, 1990; Dineen, 1992). Diego de Landa had a genuine interest for the Mayas, but he fought against their religion. He ordered the conquistadors to burn as many of the Mayan bark-cloth books, or rather manuscripts, as they could find. Diego de Landa thought these books contained nothing but superstitions and falsehoods of the Devil (Brunius, 1992). Only three of the manuscripts survived, each called a *codex*. These manuscripts are now kept in museums in Dresden, Madrid and Paris. Pictures are painted in red, yellow, blue and black.

The Indian civilizations in Central America and in Mexico all had several gods. People were very religious and worshipped the powerful forces in nature. The gods appeared in various forms and ruled over all aspects of human life. Gods decided on birth and death, on rain and dry weather, on warmth and cold weather, on good crops or bad crops which results in hunger and starvation. The Maya priests read in their calenders, and made astrological interpretations of their astronomical observations. They knew what kind of sacrifice and what kind of religious ceremonies that were needed in each case in order to make the gods happy. Several of the gods demanded blood, above all blood from humans. When it was needed a person was placed on a special altar. Several priests held the person to be sacrificed. The master of ceremonies used a sharp knife of flint or obsidian and cut the heart out of the body. Then he offered the heart to the god. Later the body was prepared for a ritual meal (Salmoral, 1990; Dineen, 1992). Some of the gods where pleased with more simple sacrifices, like

blood from humans or animals, incense, pearls, beautiful and rare feathers or products from farming.

The superior gods of the Mayas lived above the earth on nine levels in heaven (Harrell, 1994). The most powerful gods lived at the top level. Heaven was supported by four gods standing in the four corners of the world and suspended above the world like a ceiling. Red was the holy color for east, black for west, white for north, and yellow for south. In my view we can name the hanging heaven *the sacred square of the Mayas.* Mayas believed that all the gods and all human beings descended from father sun and mother moon. The moon goddess looked out for women's activities, particularly weaving and childbirth. There are special temples for the sun god as well as for the moon goddess in several Maya cities. In my view we can name the sun and the moon *the sacred circles of the Mayas.* Since these gods lived high in the sky it was necessary to build their altars and temples as close to the gods as possible.

According to the legends the god *Quetzalcoatl* was one of the most important gods in the city of Tula, north west of Mexico City (Blacker, 1965; Moltke-Hoff, 1990). Tula was the center for the Toltec culture. At its height, a period of 300 years, from the A.D. 900's to the 1200's, Tula may have included up to 30,000 inhabitants. Before that Quetzalcoatl was an important god in the older city Teotihuacan, north east of Mexico City. During a long period of prosperity, from the B.C. 200's to the A.D. 700's, Teotihuacan sometimes had more than 125,000 inhabitants. Later the Aztecs revered him as the god of light returning from the east. That was the reason for the weak resistance and easy surrender to the Spaniards.

For the Toltecs Quetzalcoatl was the god of the wind, of learning and of knowledge (Salmoral, 1990). He fertilized the ground and he was very special to the priesthood. In Tula Quetzalcoatl used to be disguised as a Toltec ruler, Topiltzin Quetzalcoatl, but he could also appear as an eagle, as well as a big snake. Thus Quetzalcoatl was called "the Great Feathered Serpent". According to Mayan legend a prominent war god chased Quetzalcoatl out of Tula in the joint between two time cycles, A.D. 987 (Coe et al., 1986). Together with a group of people Quetzalcoatl fled in a boat across the sea and moved to the city Chichén Itza, strategically located in the center of the Yucatán peninsula. There he changed his name to *Kukulcan* (Blacker, 1965). The Mayans regarded Kukulcan as the great organizer who founded cities, formulated laws and invented the Mayan calendar.

The "Moving picture" in Chichén Itza

Today Chichén Itza, 120 km east of Mérida, may be the most famous of the Mayan ruins, and it is also the best excavated and restored. This ancient city was already founded 445 A.C. The city covers an area of approximately six square kilometers.

It was the religious and political center for the whole Mayan culture during the second height, from the A.D. 600's to the 900's, (Harrell, 1994). The Itzá, a group of Maya from Guatemala, entered the Yucatán peninsula and conquered Chichén Itza in 918. In about 975 the inhabitants had to surrender to the Toltecs. As noted above they forced the Mayas to worship their god Quetzalcoatl with the new name Kukulcan. Toltecs and Mayas built several new buildings in order to develop Chichén Itza into a better version of Tula.

Chichén Itza became a strong central machinery of power on the Yucatán peninsula. The cities could no longer survive just by crops from the poor soil in the jungle. People in the ruling cities got their food by trade and they required taxes from people whom they had conquered in war. During the 12th century, the cities Izamal and Mayapán joined forces, and together they defeated Chichén Itza. Mayapán became the new capital and Chichén Itza was abandoned. The Spaniards came to Chichén Itza in 1541. The remains of the abandoned Chichén Itza were re-discovered at the end of the 19th century. The ruined city was cleared from trees and other plants and partly reconstructed in the 1920s and 1930s.

On top of the big pyramid in Chichén Itza is a temple built on a square platform. (As noted earlier the heaven was a square.) The temple, *El Castillo,* (the castle) was completed about 830 A.D. for the god Kukulcan. Actually the pyramid is a huge calendar, rising 21 meters above the jungle floor. The view from the sacred square platform is magnificent. You can see that the original city stretched for miles in all directions out to the jungle. From this main temple you have a view of several other buildings like the "Pyramid of the Warriors" where a stiffly posed figure called "chac mol" holds a receptacle for offerings, the "Pyramid of the Jaguar", and the "Ball Court", all more spectacular than the buildings at Tula (Coe et al., 1986). Chac mol was the Mayan divine messenger. Twenty or so structures of the several hundred at the site have been fully explored.

The pyramid is built in nine square terraces or levels, one for each month in the Mayan calendar, also indicating the nine heavens; 54 indented squares, one for each week; and 365 steps, one for each day of the year. Each side of the pyramid has a steep staircase with 91 steps. All the steps and the square platform makes 365. At the bottom of the staircase at the northern side of the pyramid, there are two snake heads in stone, which represent Kukulcan.

The sun travels 182 days to the north and returns 182 days to the south again every Mayan Earth year. This is the season or cycle of the solstices. At the midpoint of this season/cycle is another cycle of the east and the west called the Equinoxes. On the Equinox, the sun crosses at a center point of all four seasons making exact 90 degrees angles directly on top of the pyramid of Kukulcan. At the vernal Equinox (March 21) and at the autumnal Equinox (September 21) up to 40,000 people gather on the ground in front of the pyramid. They want

to experience a remarkable phenomenon, a "story" produced by light and shadow on the pyramid. These days the light from the dying sun casts shadows from the terraces in such a way that an illuminated image of a snake appears on the northern staircase. During the hours before sunset "the feathered serpent" appears to move, slither and wriggle from his temple at the top of the pyramid and down to the ground. To the Mayans, this represented their god coming down to reward his loyal followers and to ensure a good harvest.

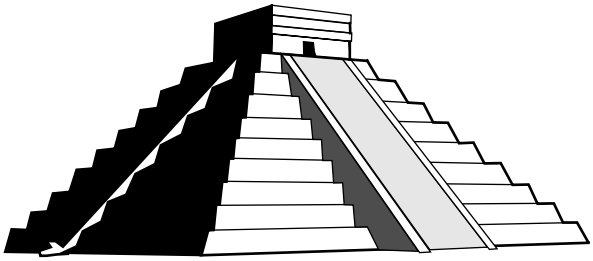

Figure 2. At El Castillo "the feathered serpent", Kukulcan, appears to move from his temple at the top of the pyramid and down to the ground.

It is the mathematical exact precision with attention to solar astronomy and geometry in the construction of the huge calendar pyramid, and the play of light and shadow which produces a "movie" twice a year. The continuous images are formed by seven illuminated triangles on the dark stones of the staircase. To the Mayans these seven triangles represent the awakening of seven centers of the physical human body and this illustrates their connection with the group of stars called the Plejades (Yaxk'in, 1995). This may, in fact, be the oldest "movie" in the world, seen by many thousands of people throughout the centuries. In my view these images of the feathered serpent can be called *the sacred triangles of the Mayas.* No doubt the Mayan culture was far ahead of its time.

In a sacred prophesy in the year 1475, before the arrival of the Spanish invadors, "The Supreme Maya Council" revealed that the following two cycles of 260 years should be a decline of the culture and for the worship of the sun god (Yaxk'in, 1994, 1995). There should be a "dark period" for humanity. 520 years later humanity should leave a "time of belief" and look forward to the beginning of prosperous times for the next 260 years, with a new interest in worship of the sun. In the spring of 1995, humanity was reawakenes into the "Age of Knowledge". Many researchers have written that we now have left the "Industrial Age" and entered the "Age of Information" or the "Age of Knowledge". Yaxk'in (1995) explains how to perform a simple solar ceremony for the modern sun-worshipper. Facing the rising sun the sun-worshipper begins to mediate and

says the name of the sun K'IN (K'ieeeeeennn) seven times for the body, seven times for the spirit, and seven times for the awakening of the cosmic human.

Some other examples of sun-worshippers

Around the world people have worshiped the sun throughout history. Also many other monuments from the past demonstrate that people knew about the movements of the sun. A "four-storied" temple-topped pyramid in Tula, called Pyramid B, was an inspiration for the architecture of the Pyramid of the Warriors at Chichén Itza. According to maps in Coe et al. (1986) pyramid B has approximately the same geographic orientation (15° NE) as El Castillo (17.5° NE) and the Pyramid of the Warriors. Tula is 1,000 kilometers west of Chichén Itza. Pyramid B has only got one staircase, mainly facing south. Thus there are no serpent-like shadows at sunset. The staircase to the large "Sun-pyramid" in Teotihuacan mainly faces east and is illuminated at sunrise. Also this pyramid has approximately the same geographic orientation (15° NE). At Dzibilchaltun, also on the Yucatán peninsula, long streams of sunbeams hit the exact center of two windows opposite each other while at Edzna, Campeche, the mask of the sun god is beautifully illuminated during the Equinox.

Newgrange (3,400–3,000 B.C.), is an interesting old prehistoric grave-field in Ireland, in Western Europe. This neolithic site has most impressive megalithic monuments made of large stones and used as tombs or places of ritual. The most famous passage-tomb was originally built about 3,100 B.C., on top of a hill. Today it is restored. The monument consists of a turf mound almost circular, 200,000 tons of stone, 79–85 meters in diameter and 13.5 m high, containing a passage leading to a burial chamber. Outside the base, 12 out of the original estimated 38 large boulders form a ring of about 104 m in diameter. The base of the mound is retained by 97 large stones, many with carved designs of spiral, lozenge, zigzag and other symbols. The grave was built so that the very first beams of light from the rising midwinter sun (December 21) exactly illuminates an altar-stone inside the main burial chamber for about twenty minutes (Burenhult, 1981). The light passes a small, rectangular shutter, above the entrance to the 19 m narrow, uphill slope leading to the 6.5 x 6.2 m burial chamber, 6 m from the floor to the corbelled roof. For this to happen it is necessary first to remove a stone, fitting the shutter 25 m from the altar. According to Irish mythology, Newgrange was the alleged burial place of the prehistoric kings of Tara, and also the home of a race of Irish supernatural beings, the people of the godess Danu.

Another very impressive ancient sophisticated construction and monument is Stonehenge on the Salisbury Plains in the southern part of England (Coe et al.,1986; Stora Focus, 1987–1989). Today Stonehenge is a group of huge, rough-cut stones. In the past, thirty blocks of grey sandstone, each about nine meters

in length and weighing up to 50 tons, stood in a circle with a diameter of 30 m. A continuous circle of smaller blocks was laid on top of them. Inside was a circle of about 60 blue stones. Inside this inner circle were two sets of stones in a U-shape, opening toward the northeast. Some of the stones had to be brought some 380 kilometers to this site. Stonehenge was constructed during a long period of time, from 2,800 to 1,550 B.C. Every stone was carefully placed in a calculated position with reference to the movements of the sun, the moon and the seasons. Stonehenge was designed as an observatory, and the openings in the arches were probably used to make intricate astronomical observations. A special stone was set to cast a shadow 25 m away on a stone altar inside the inner U-shape at dawn of the summer solstice (June 21). An earth wall about 97 m in diameter surrounded the monument. There are over 900 other stone circles found throughout Britain and Ireland, although none of them are as elaborate in their structure as Stonehenge. Also the great pyramids in Egypt were positioned with reference to the movements of the sun.

We may conclude that circles, triangles and squares have been used as important symbols by mankind for thousands of years.

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Graphic symbols

Abstract. *This paper includes a study of 52 different pedestrian warning and information crossing road signs from 32 different countries. Every situation and every context demands a consistent use of symbols, an explanation of the symbols used, and learning of the meaning of those symbols. Well-designed symbols can be used, and can work in different cultures, in different parts of the world.*

Introduction

The use of symbols have a long tradition. Symbols first appeared as paintings or carvings on caves and stone walls as early as 50,000 BC, with the first depiction of humans dating back about 11,000 years (Dewar, 1999). There is a need for various symbols in modern societies. Taking up only a very small amount of space, symbols can convey information, equivalent to one or more sentences of text. Quirk, Greenbaum, Leech, and Svartvik (1985) noted that pictograms most reliably can substitute for words in "block language"— single-word captions, headings, and labels — as distinct from sentenced language. Eco (1976) suggested that the verbal equivalent of an iconic sign is not a word but a phrase or indeed a whole story. This is, of course, also the case with the large number of Chinese kanji-characters, designating different words and sometimes phrases. The modern symbols typically found in airports and in travel guides are intended to convey generalities of the same order of abstractness as words. Their characteristic graphic neutrality is perhaps the most significant aspect of their invention by the Isotype Institute (Neurath, 1936).

Symbols may be visually more distinctive than text. Their syntax and semantics may be simpler. Image perception is rapid, virtually "instantaneous." Reading and comprehending the equivalent message in words takes much more time, and may fail if it is hard to read the text. So symbols permit rapid reading and comprehension, and they may require less time and effort for learning. This is important in numerous situations, e.g., in traffic, in industry, and in aviation. With the increase in international travel and trade, there is a growing need to communicate with people who do not understand the language of the country they are in. The use of symbols is one of the most common ways to deal with this situation. However, there may also be some disadvantages with symbols.

Symbols may be less efficient than text in conveying abstract, as well as detailed information.

When designers in different countries are working on similar problems they may create different solutions and different designs. In each case, they may have clear intentions and objectives with his or her information sets. However, it is always up to the interpreter/s to conceive or misconceive information, to use or not use it.

It is reasonable to assume that (1) a specific message may be communicated to the receiver/s or interpretor/s with several different symbols. It is also reasonable to assume that (2) a specific symbol may be used to communicate several different messages. If the assumptions above are correct it would indicate that (3) we will normally have to learn the intended meaning of symbols.

Different representations

Visuals can be classified according to various criteria. Doblin (1980) classified iconographic (visual) information into several categories: *isogrammatic* (photography, drawing, and drafting), *diagrammatic* (charts, graphs, or diagrams), and *ideogrammatic* (symbols that attempt to convey a highly specific meaning, such as a road sign). Cochran (1987) distinguished between actual events/objects, *iconic re-presentations*, and *arbitrary representations*. Examples of iconic representations are film and TV-images, still photographic pictures, and realistic art work. Computer graphics, symbols and signs, and words are all examples of arbitrary representations. Here, no cues from actuality are left. Hunter, Crismore, and Pearson (1987) presented a classification as points along a continuum from realistic to abstract: photography, artwork, diagrams and maps, graphics and formulae, tables and charts, orthography (icons), and verbal symbols.

For Wileman (1993) all kinds of representations of any object are symbols. He argues that there are three major ways to represent objects ranging from concrete to abstract representations. The first group, *pictorial symbols*, includes photographs and illustrations or drawings. Viewers should easily be able to translate a pictorial symbol to a real-world example. The second group, *graphic symbols*, has image-related graphics, concept-related graphics, and arbitrary graphics. Image-related graphics can be characterized as silhouettes or profiles of the object. Concept-related graphics look like the object but have less detail than image-related graphics. Arbitrary graphics are abstract symbols for objects, constructed out of the designer's imagination. The third group, *verbal symbols*, is divided into two sub-groups, verbal descriptions and nouns or labels. Verbal symbols can be understood only by people who comprehend the language used to describe the objects.

However, in my view, there seems to be no major difference in "abstractness" between the abstract arbitrary graphic symbols and the verbal symbols. Based on the above classifications I prefer to distinguish between two main categories of representations, (I) figurative representations, and (II) non-figurative representations (Pettersson, 1993). Figurative representations include two subgroups: (1) visuals and (2) graphic symbols. Also non-figurative representations include two subgroups: (1) verbal symbols and (2) non-visual representations.

In this paper, the main focus is on *graphic symbols*, and its three subgroups pictorial symbols, abstract symbols, and arbitrary symbols. Graphic symbols may represent objects as well as ideas. Functional graphic symbols are actually older than words. They are found in every culture however primitive. In specific areas symbols are a supplement to all languages to help create better and faster understanding. Graphic symbols have evolved to the point of universal acceptance in such areas as music, mathematics, and in many branches of science.

Pictorial symbols (or representational symbols) are "image related" and simplified pictures. Pictorial symbols resemble the objects they represent. They can be characterized as *silhouettes*, shadows, or profiles with no surface detail. A traffic sign with a silhouette of a locomotive, to denote a railroad crossing, is an example of a pictorial symbol. (See Figure 3.)

In the design process, some pictorial symbols may be successively simplified into figurative and *abstract symbols*. To some extent, abstract symbols still look like the objects they represent but they have less detail than pictorial symbols and they may consist of several graphical elements; dots, lines, and areas. In athletic contests, like the olympic games, abstract graphic symbols are often used to denote the different kinds of sports. Good abstract graphic symbols are intuitive and we should be able to understand their meaning without any problems.

Some figurative symbols are *arbitrary symbols*. They are invented and constructed out of the designer's imagination. Usually arbitrary graphic symbols have no resemblance at all to the objects or the ideas they represent. Many are based only on the use of geometric shapes and colours. Many signposts and some traffic signs are examples of signs with arbitrary symbols. Arbitrary symbols are unambiguous by convention. We agree and decide on their meaning. Just as new terms have to be learned when we begin to study a new topic, we have to learn arbitrary graphic symbols, and every motorist have to pass a test in order to get a driver's licence.

Use of symbols

Pettersson (1985, 1987) concluded that *perceived image content often is different from intended image content*. Even simple pictures and also symbols may cause many different associations. A given set of basic picture elements and symbols can be combined to form completely different images. Moriarty and Sayre (1993) studied intended and perceived advertising meanings. They also found a high level of *disagreement between intended and perceived messages*. More than half of the responses were different from those intended, and expected by the message creators.

Symbols must be meaningful, legible, learnable, memorable and used consistently (Dewar, 1999). The meaning of a symbol is seldom easy to guess. Pettersson (1989, 1993), Griffin and Gibbs (1993) and Olmstead (1999) found that graphic symbols were interpreted in many different ways. Sometimes only a few persons will understand the intended meaning of a symbol. Thus, the sender will always have to supply explanations for the symbols used in any specific situation.

Griffin *et al.* (1995) studied how international business people interpreted and understood commonly used clip art graphic symbols. The symbols were taken from a Harward Graphics software package for business presentations. Based on 4.530 opinions expressed by 302 subjects in Japan, Sweden, Tanzania and USA, regarding 15 of the symbols in the software package, Griffin *et al.* made the following two conclusions:

- There are many ways to interpret symbols. Very few people share the same understanding of any given symbol.
- There are strong cultural differences in interpreting the meanings of symbols.

Four *verbal symbols* resulted in many interesting observations. Symbols in this category were either understood or not understood at all. There were 90% appropriate answers from the subjects in the USA and 80% from the subjects in Sweden. For Tanzania and Japan, the corresponding numbers were 27% and 29% respectively. The rank ordering of the mean numbers of appropriate answers for seven *pictorial symbols* was 80% for USA, 69% for Sweden, 60% for Tanzania, and 48% for Japan. The remaining four *abstract symbols* were the most difficult symbols for all audiences to comprehend. Here definitions differed strongly by symbol and by country. In this study, it was common for the subjects to give several meanings for each symbol. For example, the 81 Swedish subjects gave 20 different interpretations of a symbol with the shape of a star.

Cochenour and Rezabek (1998) studied the interpretations of 21 sepulchral symbols. Respondents showed a wide disparity regarding their ability to understand the meanings of the symbols. Nineteen percent of the responses indicated

that no meaning at all was conveyed, while 31% were considered as "understanding of the intended meaning". It was concluded that symbols carry a variety of meanings for different people and when used alone as a means of visual communication cannot be expected to always convey a simple and direct meaning. Cochenour, Rezabek and Westhoff (1999) studied the interpretations of 12 graphic symbols. In this case, 96 respondents showed a wide disparity in their interpreta-tions, with as many as 51 different categories of meaning for a single symbol. The average number of no-meaning responses was 13.

Nilsson and Lindqvist (1995) examined a random selection of telecom publications. They browsed about 1,000 pages. From this material Nilsson and Lindqvist selected 100 pictures and registred about 350 symbols. This study concluded that:

- A certain meaning is explained with several different symbols.
- A certain symbol has several different meanings.

At the end of his book on writing for science and technology, Kirkman (1992) noted the possibility of using symbols in international communication (page 155):

> Perhaps, since use of words causes so much difficulty in international communication, we should abandon words wherever possible, and use icons instead.

Kirkman used the term "icon" in the same meaning as I use the term "symbol" here. Symbols may very well become more and more common in international communication. Kirkman commented (page 156):

> I have no doubt that we shall gradually have to include more and more icons in our presentations of information, especially in our onscreen presentations.

Many pictograms are culturally biased (Mangan, 1978) and thus arbitrary to those from other cultures. For example, when using a guidebook with symbols, we often have to look them up in a key in much the same way as we look up unfamiliar words in a dictionary. Their iconic origins may only become apparent after we are aware of their intended meaning (Waller, 1987). Baron (1981) reported that iconicity is a surprisingly unimportant factor in the learning of sign-languages for the deaf, autistic, or mentally retarded.

There are many reasons to use symbols. Graphical symbols can be used effectively in manuals and on screens to help readers to quickly recognize and *identify* a specific message. Symbols can be used to create an *overview* and provide

a holistic perspective. This property is utilized in maps and informative signs as well as in catalogues and project reports.

Symbols can be used to illustrate the spatial and geographic *position* of different objects or services. One example is the floor plan of an exhibition hall with symbols designating the location of telephones, lavatories, information booths, and refreshment sites. Another example is maps with cartographic symbols for objects and conditions. Symbols can be used to illustrate *size* relationships and to supply numerical and statistical information. Many symbols in maps are such examples.

Symbols can be used to *represent* an organization, a service, or a product. Trademarks and logos are very common in marketing, advertising, and public relations. As a rule, promotion begins with a name, followed by the name and a symbol. Ultimately, the symbol alone suffices. Examples are McDonald's yellow M, and Shell's scallop. Symbols can be used in graphics and in image maps for easy *navigation* in databases. Symbols can be used to *supply instructions* and *information* about appropriate behavior in different situations. Numerous examples can be found in catalogues and timetables. Many symbols are used for *warnings*. Dewar (1999, p. 286) divides symbols into five main categories: (1) industrial and occupational (in the workplace); (2) representing methods (machines, instructions); (3) management of public places (transportation, museums, hospitals); (4) knowledge; and (5) particular activities (sports).

Warnings

As previously noted many symbols are used for *warnings*. Wogalter (1999, p. 94) concluded that warnings should contain certain elements:

- a signal word such as "Danger" and "Caution" that enables people to recognize that the message is a warning, that a hazard is present, as well as providing information on the hazard level (with "Danger" signalling more serious and probable injury than "Caution");
- a description of the hazard, e.g. in the case of a no diving sign, a statement such as "Shallow water" provides information about the specific danger involved;
- a description of the consequences that could occur if gthe person fails to obey the warning's directions, e.g. "You can be permanently paralysed";
- the directions or instructions, i.e., the specific actions that should or should not be done, e.g. "No diving".

In order to be efffective a warning must reach the intended audience and make them adopt the desired behaviour. Several steps are needed here. Initially

any warning, and any symbol, must attract and capture the *attention* of the intended audience, the persons who need the information. The message must be legible at the appropriate distance, and must often be legible when seen for a short period of time under bad lighting conditions. A driver on a highway may only have a second or two to read a signpost. Then the message in the warning must be mentally processed and *understood* correctly by the intended audience. The action to be taken should be immediately obvious. Furthermore the message in the warning must be able to motivate the audience to *comply* with the desired behaviour.

Wogalter pointed out that warnings should have properties that allow them to be seen in degraded conditions such as low illumination, smoke or fog. In addition warnings should be adequately lit by direct light or by back-lighting and/or have good reflectance so that they are visible under reduced-light conditions.

Design of graphic symbols

Dewar (1999) pointed out that the specific criteria for individual symbols or sets of symbols depend on their application. Legibility distance is essential in the case of traffic signs and many building signs, but not for symbols on maps or consumer products. There is a need to have as much *uniformity* as possible across different information systems. Symbols are often composed of simple graphical elements, such as lines, circles, ovals, squares, rectangles, triangles, or combinations thereof. Distinctively shaped letters are often utilized. Regular, simple, geometrical figures are identified more quickly than complex ones. Keates (1982) noted that discriminatory responses to map symbols depend on contrast in *form, dimension,* and *colour*. The problem of discrimination is generally more critical in monochrome maps, in which only contrasts in form and dimensions are possible for lines and small symbols.

The graphic symbol should be *simple* and *clear* with a distinct contrast to the background. A clear and stable figure to ground articulation is essential (Easterby, 1970; Dewar, 1999). The figure ("foreground") should be stable, i.e. spontaneosly organised as one unit. This is achieved by close boundaries, appropriate line thickness and any other graphical means that help the visual system to organise the figure as one unit. It is most appropriate to use silhouette (side) views of certain components such as vehicles (Dewar, 1999). The graphic symbol should be as symmetrical as possible. It should appear in an *optimal size*. A good symbol is designed so it can be used in many different situations and in many contexts. For example, the McDonald's M or "golden arch" is designed to work in every conceivable size, from a few millimeters high in a brochure to more than six feet high in outdoor signs. It is often an advantage that a symbol is

iconic, that is, that it looks like the real thing it represents. Then it may be intuitive to the users. In technical and scientific systems and documentation, hardware may be symbolised by squares and rectangles or the like. Software may be represented by "softer" forms, such as circles or ovals.

Graphic symbols often make use of bright colours to intensify their meaning – in fact in some instances a change of colour creates a diametric change of meaning. Common hues are pure yellow, red, blue, green, white and black, or combinations of the same. Colour creates instant impact. It becomes a vital part of the first impression created. Industry employs colour coding in many areas. The countless wires in a complex cable are instantly traced by their hue; the colours of knobs and buttons on vehicles and machinery signify what they control (Dreyfuss, 1972). However, since many people are colour-blind colour can only be used to code the information redundantly. Colour may be combined with shape or position. Complementary colours contrast and provide a warm – cool effect.

Warnings should have high contrast relative to the background (Barlow and Wogalter, 1991; Sanders and McGormick, 1993). They should have large, legible bold-faced alphanumeric characters (Wogalter, 1999). Legibility of symbols can be enhanced with the application of a few simple guidelines:

- Use realistic figures rather than abstract forms.
- Make important figures and characters large.
- Eliminate unnecessary elements.
- Use solid figures, not outline figures.
- Maximize separation between features in symbols.
- Maximize the luminance between a symbol and its background.
- Maximize the colour contrast between a symbol and its background.

According to Keates (1982), the use of colour on maps introduces a large number of variables which can enhance contrast, and therefore extend the number of perceptual differences that can be employed in discrimi-nation. The effect is to *aid legibility*, and therefore to increase the total range of information which the map can present. Shape and colour components are often used for designating a link or relationship between groups of messages. The recognition of geographical features is much enhanced when areas are differentiated by hue. At the same time, complex colour arrangements may raise problems in discrimination, so that although multi-colour maps enlarge the graphic possibilities, they also increase the probability of errors in the judgment of discrimination. According to Keates (1982), the most common case of quantitative judgment on maps occurs in the use of proportional symbols, that is, point or line symbols constructed to represent specific quantities.

Many symbols are officially recommended by standardisation bodies like ISO (International Standards Organisation) and IEC (Commissioin Electrotechnique Internationale). Symbols are employed in different media. They are static and immutable in graphical media and may be more changeable in computer-based media. As noted in the introduction designers in different countries may be working on similar problems, and they will often create different designs. Most, if not all, countries have traffic signs. In order to study similarities and differences in the design of a highly restricted message I have analyzed pedestrian warning and information signs. This study is presented in the following section.

Pedestrian crossing road signs

Traffic signs and signposts are various devices with symbols, placed along, beside, or above a highway, roadway, pathway, or any other route in order to warn, guide, and regulate the flow of traffic. The symbols may also be painted on the streets, and sometimes on the walls of houses. The traffic may include many kinds of motor vehicles, bicycles, pedestrians, equestrians, and other travelers. Road signs and signposts may be divided into four main groups: (1) warning signs, (2) mandatory signs, (3) prohibitory signs, (4) information signs, and the STOP sign. Today road signs are manufactured in different materials such as aluminium, galvanized sheet iron, and flat or canned panel. The symbols on the signs may be painted, printed or duplicated in other ways. The motifs are designed in different ways even if they carry the same or similar messages.

In communication senders want to communicate messages or make information sets available to receivers or rather interpreters. In the case of warning for and information about pedestrian crossing road signs the city authorities are the senders. The *warning sign* for a pedestrian crossing (Figure 1a) convey a simple, but important message to the *motorists*: "Look out and slow down, there is a pedestrian crossing ahead." This particular sign is used in Germany and in Luxembourg. The wide line along the edge of the triangular sign is red. The triangular area in the middle of the symbol is white. The three graphical elements representing a person and the five graphical elements representing street lines are black. This symbol is classified as abstract. The warning sign is usually triangular, sometimes with soft corners. The actual symbol consists of a wide line forming a red triangle on a light background. Graphical elements, dots, lines, and areas, are combined to form a simple figurative representation of a person. Some graphical elements may also represent street lines showing a pedestrian crossing.

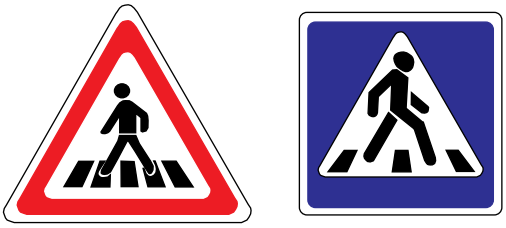

Figure 1. A warning sign and an information sign, from Germany and Luxemburg.

However, the *information sign* about a pedestrian crossing (Figure 1b) convey slightly different messages for two different groups of receivers. The message to the *motorists* and other road-users is: "Look out and slow down, pedestrians are told to cross the street here." The message to the *pedestrians* is: "This is the place where you should cross the street." The information sign is usually rectangular, sometimes with soft corners. The actual symbol consists of a large blue rectangle with a light triangle. This particular sign is from Lithuania. The triangle is white. The four graphical elements representing a person and the three graphical elements representing street lines are black. The person appeaers to be running to the right. This symbol is classified as abstract. In Lithuania there are also signs with the person moving to the left. Graphical elements, dots, lines, and areas, are combined to form a simple figurative representation of a person. Some graphical elements may also represent street lines showing a pedestrian crossing.

In several locations this information sign is replaced by traffic lights. Traffic lights convey more distinct and "sharp" instructions to motorists as well as to pedestrians than pedestrian crossing warning and information road signs. Here the instructions may be expressed as "Drive now!," "Do not drive!," "Walk now!," and "Do not walk!" respectively. The design of traffic lights may vary substantially. However, design of traffic lights is not included in this study, nor the sign explaining that children may be playing alongside the road as well as on the road.

Data

I have studied 52 different pedestrian warning and information crossing road signs from 32 countries (Argentina, Australia, Austria, Belgium, Chile, China, Cyprus, Czech Republic, Estonia, France, Germany, Ghana, Iceland, India, Ireland, Italy, Jordan, Lithuania, Luxembourg, Malta, Mexico, Monaco, Norway, Peru, Poland, Portugal, South Africa, Spain, Sweden, Switzerland, Turkey, and USA). Some of these road signs were brought to Stockholm for a public exhibition in 1998. The exhibition *The World Walks in Stockholm* was put together

by the graphic designer Anders Körling as an event during *Stockholm '98, Stockholm — Cultural City of Europe 1998*. I have taken photographs of the crossing road signs at this exhibition. I have also taken photographs during my travels in various countries. In addition, people have provided me with photographs of crossing road signs in a few cases. The pictures presented in this report have been scanned and retouched using Adobe Photoshop™. The design of pedestrian warning and information crossing road signs wary with respect to shape, colours, size, and number of graphic elements in the symbols.

Results

Pedestrian warning and information crossing road signs wary with respect to their shape, colours, size, and the design of the figurative representations. Differences in material and in the construction of the signs and signposts are not discussed here.

Shape. Pedestrian crossing warning and information road signs vary in shape in different parts of the world. In Europe warning signs are triangular (Figure 1a), and information signs are rectangular (Figure 1b). In other parts of the world the information sign may be rhombic or circular (Figure 2a and 2b). On the signs from Argentina and Australia the pictorial symbols are black on yellow backgrounds without indications of street lines. These symbols are classified as pictorial.

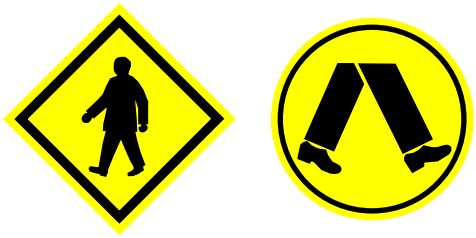

Figure 2.Signs from Argentina and Australia.

Colours. Pedestrian crossing warning and information road signs vary in colour in different parts of the world. In Europe warning signs usually have white, black and red colours (Figure 1a). In Sweden warning signs are yellow, red and black. In many countries the information signs are blue, white and black (Figure 1b). In some countries the colours are white and blue; white, yellow and black; or yellow and black (Figure 2). The figurative representations are usually black, on a white, blue or yellow ground.

Size. Pedestrian crossing warning and information road signs vary in size in accordance with different situations. In this sample the smallest sign is 40 cm (Cyprus) and the largest is 102 cm (Argentina). Most signs are between 55

and 75 cm. Thus the impression of the pictures printed here corresponds to the impression from viewing the real signs on a distance of five to seven meter.

Symbol. The symbol on pedestrian crossing warning and information road signs vary to a large extent. Almost all are different with respect to their design. The person in the symbol is always *"Mr. Walker."* Nowhere is the figure representing a woman (Jofs, 1998). Mr. Walker is an *abstract graphic symbol* (27), or a *pictorial graphic symbol* (25). As would be expected, there are no *arbitrary graphic symbols* in this sample of symbols. In one case (Australia) the sign only shows the lower parts of the legs and the feet (Figure 2b). For some reason most figures on the signs (44) are crossing the street to the left. The remaining figures (8) cross in the other direction, to the right. Estonia and Lithuania have both versions of signs (Figure 1b).

Most figures (42) seem to be walking across the street over to the other side (Figure 3), but some (9) appear to be running (Figure 1b). In one case (Mexico) the figure appears to be standing and waiting for a possibility to cross the street. In two other symbols from Mexico the person appears to be walking. Some symbols are very clear and distinct, others are "blurred" by a large number of graphical elements. In figure 3a the person is an abstract graphic symbol on the warning sign from Malta, and a pictorial graphic symbol on the right sign, figure 3b, from Switzerland. In both cases the person is apparently walking to the left.

Figure 3. Signs from Malta and Switzerland.

The number of graphical elements that are used to build the Mr. Walker figure vary (1–4), as the total number of graphical elements (2–21) in the symbols. Mr. Walker consists of one graphical element in figures 2a, 3b, and 4. He is built of two graphical elements in figure 3a. In figure 1a Mr. Walker consists of three graphical elements, and in figures 1b and 2b four graphical elements are used.

The painted *street lines* form a graphic world of their own. The number vary to a large degree. In some cases the street lines may actually confuse people. Figures 2a and 2b has no street lines. In figure 1b there are three graphical elements representing the street lines. There are five graphical elements representing the street lines in figures 1a and 3b. Seven graphical elements represent the street lines in figure 3b, and there are 19 distinct elements in figure 4. However, on the sign from France Mr. Walker consists of only one graphical element.

I don't know to what extent the number of street lines vary in different countries. In Sweden there are four graphical elements on the symbols representing the lines painted on the streets. The number of painted lines may vary.

Figure 4. A sign from France.

Discussion

There are probably pedestrian crossing road signs in most cities, at least where there are cars. In accordance with international conventions and national legislations on road signs and signals, most road signs have a similar design. For example, the official manual for signing in the United States is the *Manual of Uniform Traffic Control Devices*. Warning signs are triangular. Information or instructional signs are rectangular or rhombic. Prohibitory signs and mandatory signs are round, but with different colours. However, the symbols on the signs may differ in several respects. Every country has its own version, or rather versions, because some road signs differ between regions. Some of these signs may be old versions, waiting to be replaced.

There are several requirements that must be fulfilled for road signs to be effective communicators of information. The *design* of the symbols, as well as the *contexts* in which the signs appear are important factors for our perception of the message. The abstract or pictorial graphic symbol on the sign must have good legibility and be easy to read from a distance. Obviously pedestrian crossing road signs must be placed in such a way that the motorists as well as the pedestrians can see them. Signs should be placed as necessary for safety and proper regulation of traffic. However, the use of too many signs within a given location severely reduce the effectiveness of each individual sign at that specific location. There is a distinct risk that we will not see, or pay attention to, some of the signs.

It is quite obvious that traffic symbols are designed in many different ways, even when they convey the same or similar information to people who see them. This may not seem to be an important issue, since people have to *learn the meaning* of all important symbols within their own society. However, with respect to the fact that international travel seems to increase all the time, and more people visit different countries, it would probably be an advantage to have a "world

standard" for a set of basic symbols, including traffic signs. This would probably reduce the number of misunderstandings and accidents in the traffic.

Conclusions

This paper supports the assumptions noted in the introduction. We may conclude that:

1. A specific message may be communicated to the receivers or interpreters with several different symbols.
2. A specific symbol may be used to communicate several different messages.
3. People have to learn the meaning of all important symbols within their own society.

The first two points may also be visually represented in the following two schematic pictures (Figure 5, and Figure 6):

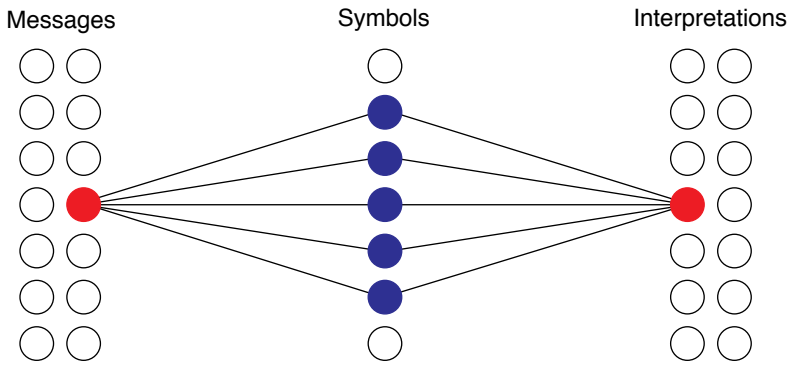

Figure 5.A specific message may be communicated to the receivers or interpreters with several different symbols.

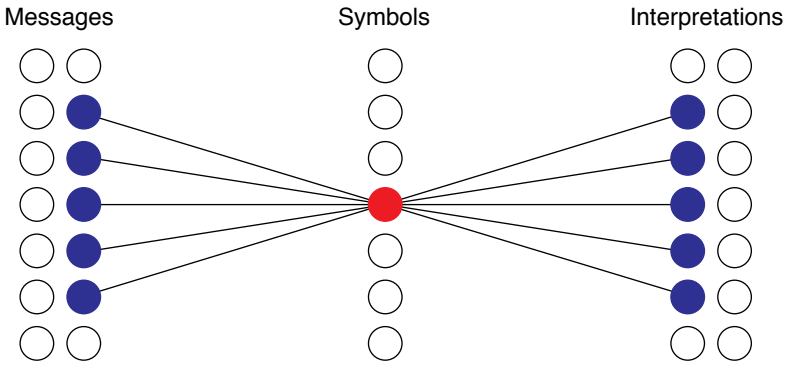

Figure 6. A specific symbol may be used to communicate several different messages.

With respect to the design and the use of symbols it may further be concluded that:

1. Receivers may interpret symbols in many ways.
   – Few people share the same understanding of any given symbol.
   – People can usually not guess the meaning of symbols.
   – There are strong cultural differences in interpreting the meanings of symbols.
2. The senders will always have to supply explanations for symbols.
   – Symbols should be used in a consistent way.
   – A symbol must always have the same meaning within a specified context.
3. A good symbol is designed so it can be used in many different situations and in many contexts. A good symbol:
   – is simple and clear
   – has optimal size and good contrast in form, dimension, and colour
4. Graphical symbols may be intended to convey generalities of the same order of abstractness as verbal terms. In some cases we can see graphical symbols as visual terms. Graphical symbols may be used to:
   – create an overview
   – identify information
   – illustrate position
   – illustrate size relationships
   – navigate in databases
   – provide a holistic perspective
   – recognize information
   – represent an organization, a service, or a product
   – supply information
   – supply instructions

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At the turn of two centuries

Abstract. *This article considers the style, patterns, and purposes of information graphics while tracing some common elements and uses of such graphics in an historical sense. It consieders some similar features of information graphics at the beginning and end of the 20th century, and comments about the influence of posters on our current information graphics. The term "everyday graphics" is introduced as a subcategory of information graphics.*

One hundred years ago, at the turn of the last century, people in Paris and other large cities encountered a great variety of brightly colored *posters*, glued on walls, poles, and fences. The litographic poster was the "information graphics" of the last century.

Now, the turn of the next century is only a few years ahead. We will soon pass into the 21 st century. In everyday life, we often encounter advanced and well developed forms of information graphics–both in dayly papers and television programs. Information graphics contains verbo-visual messages on the weather, on certain events, and on products and services.

For provisions and other groups of producs, verbo-visual messages are often printed directly on the packages or on the labels. This kind of verbo-visual message is a subset o f information graphics and may be called *everyday graphics* (Pettersson, 1993).

Both posters and different types of information graphics speak to us in a direct way in our everyday lives, with well-thought-out and well-designed verbo-visual messages. Today, we can study some of the classical posters from last century in art books and in museums, such as the Musée des Arts Décoratifs in Paris. It is possible, and even plausible, that some of the information graphics of today will find their way into art and design museums at the turn of this century or at the beginning of the 21st century.

Information graphics

Information graphics, or sometimes just called *graphics*, is an information graphics product. This product consists of one or more texts and pictures, all kept together in a well thought-out graphical form, which is integrated to a well-

defined and well structured surface. Typography and layout are both important for us to perceive the message. Unfortunately, the terms information graphics and graphics are used synonymously with *infography*, that is, the design and formation of verbo-visual information.

With information graphics, the reader quickly and easily gets an *overall view* of a message, and–in addition– a possibility to deeper *detailed information*. Information graphics is, therefore, suitable as an introduction to and summary of a limited subject field. The more limited an area, the better the information graphics convey the message. However, for analysis, discussion, and study of details, text illustrated in a conventional manner offers considerably better possibilities of presenting a certain message. In graphical media, technical writers may also use texts, pictures, information graphics, typography and layout to convey their messages.

Information graphics may be classified in accordance with different criteria, such as purpose, medium, size, and the time available for production. One specific graphic may very well belong to several of these groups. The following are well-established types of information graphics: business graphics, expo graphics, factual graphics, locating graphics, instruction graphics, planned graphics, presentation graphics, signal graphics, and weather graphics (Pettersson, 1993).

Modern information graphics has its origin in the tradition of making posters and advertisements. These visual forms of communication spring from a past in older times, when pictures and texts were combined into information on circus and theatre posters, and on signs on inns. The oldest posters were created at the end of the 14th century, when printing on paper started in Europe. Leaflets with text and simple pictures were used by booksellers and traveling theatre companies and for political agitation. The posters' roots are traced back to antique Athens, where the City Fathers put up notices with regulations.

On the 15th September, 1982, a new type of daily paper was published in the USA. From a central editorial office in Arlington, Virginia, the produced pages were sent via a satellite to printing houses in eleven cities, where USA TODAY was printed. As early as after one year, the daily edition was more than a million copies. Today, the paper is widely spread in the USA and in several other countries. The paper is as fragmented as the news on television, and is often being criticized for being too superficial. USA TODAY is the paper of the television generation. It is divided into four separate sections: *news*, *money*, *sports*, and *life*. Each section has its own *cover story* and a large number of easily read mini-notices. The headings are effective, and the text is often heavily edited. The notice has replaced the article. There are many photographs, drawings, diagrams, and tables in the paper. USA TODAY introduced modern information graphics, and has been imitated all over the world. It is the most copied paper in modern times.

Posters

The breakthrough of posters was in the1830s, as a consequence of the development of the litographic printing technique. Well-known drawers created the black-and-white pictorial posters of the Romantics. At the same time, purely typographical posters were developed, where the design of letters, words, and texts became very important. The development of chromolitography established the poster as an advertisement medium in the 1840s.

The modern poster was developed in France towards the end of the 19th century. At that time, the industrial revolution had created a consumption society with an increasing demand for and offering of both products and services. The producers needed to advertise in order to persuade the customers to by their products. The simultaneous development of the more and more efficient printing method made it possible to start a cheap mass production of posters on a large scale.

We read a poster at a long distance when we pass it. Since so much different information compete for our attention, it must not take too much time to understand a message. Therefore, posters contain short and focused messages that are presented in a clear and distinct way. Typography and layout must provide good *legibility* in both texts and pictures. The most important elements must be large enough to draw the viewer in close to a point where the specifics can be presented. Texts and pictures must have good *readability.* In addition, the message must be interesting and attract attention, in order to make people willing to consider the message. These factors applied towards the end of the 19th century, and they still do. Due to communication and psychological reasons and a trademark legislation (in 1884), the shape and colour of posters were simplified in a well-balanced aesthetic cooperation between picture and text.

As early as in 1858, Jules Chéret (1836-1932) created his first litographic coloured poster in a characteristic, sweeping style. Ten years later, he returned to France after a seven-year-long stay in London, bringing modern English printing presses with him. Chéret started a mass production of posters on a large scale. Printing up to 10,000 posters per hour was realized, and at a very low cost. Chéret drew his posters directly on litographic stones. He concentrated on theatre posters and developed a unique, playful, and pleasurable style by connecting the text to the picture in a completely new way. Chéret concentrated the message in a big, central comprehensive picture, in order to accomplish maximal effect and visual impact (Hardy, 1986). Jules Chéret is often called both "the father of modern advertising" and "the father of the poster".

Chéret was probably inspired by circus posters and their tradition. On his own posters, however, texts and illustrations play as important roles. Texts and pictures complement each other; they belong together and are inseparable parts of a common graphical whole and a whole from the point of view of contents.

The words announce the contents, and the picture – often dominating the poster – describes the contents in the least little detail. As time went on, Chéret formed the actual words as illustrations. All in all, Chéret produced about 1,200 posters. Broido (1992) has listed 1,089 of these posters in an illustrated catalogue. Above all, Chéret has created and conveyed the picture of the charm, elegance, and vanity of Paris – a myth that several imitators have further developed and that still prevails today. However, the Chéret posters advertise many different types of products and services.

Figure 1. Dubonnet Aperitif. A typical poster (116 x 83 cm) designed by Jules Chéret, 1895.

Henri de Toulouse-Lautrec (1864-1901) was inspired by the use of effective colours in Japanese woodcuts, and worked with an expressive line and with strong colour centra in his posters. The pictures on the posters are metaphors, composed of hints and symbolic details. The words that fill the space between the different parts of the picture are there only to explain the picture. The function of the pictures is to tell something, without dominating the text. Toulouse-Lautrec's posters of actors, singers, and cabaret artists may be seen as a European correspondence to the Japanese woodcuts of actors, flirts, geisha, and wrestlers in the popular Japanese woodcuts.

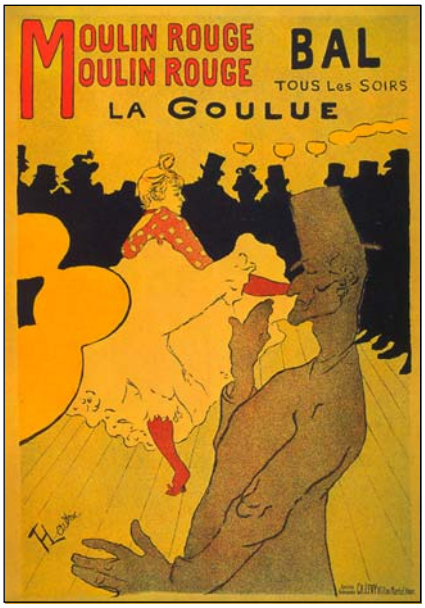

Figure 2. Toulouse-Lautrec portrayed several artists in his posters. Moulin Rouge: La Goulue, chromolitograph (191 x 117 cm), 1891.

Toulouse-Lautrec, "the king of posters", revolutionized the art of posters and gave the commercial poster status as an independent art form. A register of his complete works shows in all 350 litographies, of which about 30 are posters (Arnold, 1990). A dozen of these are among the best ever produced in everyday art.

The 27-year-old Toulouse-Lautrec became famous over a night, when his poster "Moulin Rouge: La Goulue" was put on walls and advertising pillars all over Paris in October, 1891. The Moulin Rouge poster is one of the most well-known posters in the history of art. Here, Toulouse-Lautrec works with a great simplification; a very unusual composition at that time with figures partly within and partly outside the picture, figures as silhouettes towards a lighter background, and a linear contouring of different surfaces. The poster is the result of abstraction and simplifications processes in several steps.

Toulouse-Lautrec portrayed several artist in his posters. The technique of working with simplified areas for the dancer in the poster "Jardin de Paris: Jane Avril" is in great contrast to the contrabass from the orchestra pit, in the foreground. Here, an asymmetrical framing of the picture is being formed: a first taste of art nouveau.

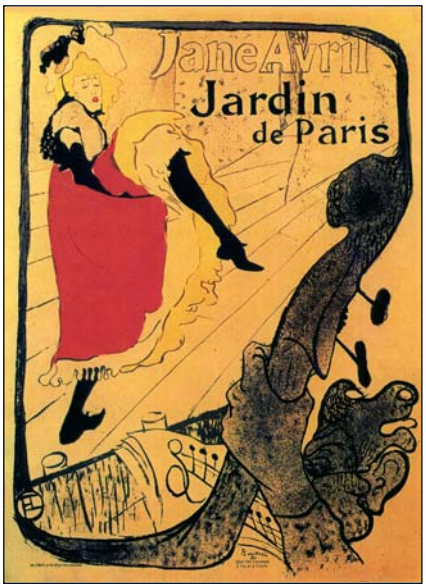

Figure 3. Toulouse-Lautrec. Jardin de Paris: Jane Avril (right), chromolitography (130 x 95 cm), 1893.

In the 1890s, "the new art" interrupted the historical cavalcade of style that had been dominating architecture, art, and art handicrafts for a long time. This style has its origin in England, where it was called *liberty*. In Belgium and France, this style was called *jugend*. The international general term is *art nouveau*. This new art dominated the European culture for 15 years, at the turn of the last century.

Art nouveau also had an influence on posters, and radically changed the relationship between pictures and texts. The posters had texts in clear typography, abstract pictures, and illustrations in the margins in the shape of decorative patterns and flourishing ornaments. The shadeless ornamentation serves the demands of the modern times on effective pictures with strong visual effects. As Henri Toulouse-Lautrec, many jugend artists were inspired by Japanese woodcuts. In art nouveau, however, aesthetic considerations are predominant. The message is no longer as sharp and clear; the message is no longer information graphics. The Czech artist Alfons Maria Mucha (1860-1939) was to become one of the most successful poster artists. Mucha produced, among other things, the first tourist posters with advertising for traveling by train to the popular seaside resorts.

Figure 4. Monaco, Monte-Carlo is a poster in art-nouveau style by Alfons Mucha, 1898.

Today, we tend to remember the artful and spectacular posters from the end of the 19th century, with advertisements for theatrical performances, cabarets, and restaurants that Chéret, Toulouse-Lautrec, and other artist created. We have forgotten all the posters that advertised everyday articles. These posters were printed in large editions, and the message reached many people. The average cost for contact was negligible. No article or product was too simple or too cheap not to be advertised on a poster. The artist that created all these posters with everyday messages for everyday products are more or less forgotten. Many of them were anonymous and worked quietly, without any attention.

During the 20th century, new printing techniques were developed. The poster of today is printed with silk-screen-printing or with offset techniques, which makes it possible to also use photographs. The constant influence by different mass media today heightens the demands on us to perceive the message in posters as quickly as possible. Therefore, today's posters have to be even clearer, simpler, more distinct, and more effective than the posters at the turn of the last century.

Everyday graphics

In several respects, everyday graphics differs from other types of information graphics. Contrary to the producer of news graphics, but in conformity with the producer of posters, the producer of everyday graphics often has time enough to plan and design the messages in an optimal way. However, the space is often very limited for everyday graphics. The amount of the article and the size of the product decide the space available for the design of the verbo-visual message. In practice, however, there is the same space for about the same amount of information on a small label as on a normal-sized poster. When we read a label of 4x4 cm at normal reading distance (30-40 cm), it corresponds to a poster of 100 x 100 cm when reading it at a distance of 7-10 metres. When it comes to reading posters, the most common way of reading is at a distance.

Just as posters, everyday graphics have short and concentrated messages, expressed in a clear and distinct way. We read everyday graphics close at hand, but the retinal picture is about the same as the retinal picture of a poster. Usually, we do not take much interest in a label or a package. The same applies as for posters: it must not take too much time to perceive the message in everyday graphics. Just one glance should be enough to perceive the contents of a package. Does the bag contain sugar, salt, or pepper? Is there raspberry jam or strawberry jam in the jar? Is the contents poisonous, or harmful for us in any other way? In several respects almost the same conditions apply when taking in information printed on a poster and on a label or a lid.

When it comes to small packages, the message still has to be designed in order to fit in all the necessary information. Sometimes, there is a national law on how to describe the contents in detail. For some products, there may also exist different types of instruction, enclosed inside the package. As producers of posters, the producers of everyday graphics are usually totally anonymous to the consumers. In other forms of information graphics, however, the names of the originators are often mentioned, and thus known. Everyday graphics may have different purposes. It may be used to instruct, to inform, and to tempt a presumptive customer to buy the product in question.

Instructing

Sometimes, schematic pictures are used to show how something is to be performed in several steps, in a practical, simple, quick, and safe way. One example is how to open a vacuum package with cheese, and another example is how to put together several separate parts in a box into a chair or a table. Symbols are often used. An arrow, for example, may be used to show where to open a package and to explain in which order and in which way to join different parts.

Informing

Everyday graphics informs on the contents of the package, and the characteristics of the article or product. When it comes to provisions, for example, there is a legislation in some countries that sanctions that some types of data must be on the package. This may be information on the contents of the product, day of manufacture, keeping qualities, producer, and place of manufacture. Also trade agreements and practice within different trades may demand that a certain kind of information – for example, the price of a certain package and the price per kilogram – is presented to the customer/user.

Figure 5. An example of everyday graphics printed directly on the aluminum lid on an individual portion of strawberry jam (life-size). The product is produced in Denmark. A large and lifelike picture of two strawberries in colour gives the reader direct information on the type of contents in the package. So does the heading "JORDBÆR MARME-LADE" (Danish), in upper-case letters. The text directly under the heading provides detailed information in the form of a declaration of contents. The white arrow in the black area is a symbol showing where to get hold of the lid and the direction where to pull, in order to open the package. The text and the symbol at the top tell that the product is being delivered to the Danish court. The text in italics under the symbol shows the name of the company that produced the jam. The address to the company is down to the right. The figures to the left were written with an ink-jet printer after the jam was packaged. 20 g is the weight of the jam. 0759-2 is probably an identification code.

Figure 6. An example of en everyday graphics printed directly on the aluminum lid on an individual portion of strawberry jam (life-size). The product is produced in Germany. A lifelike picture of three strawberries in colour gives the reader direct information on the type of contents in the package. So does the heading "Erdbeeren" (German). The text directly under the heading (white upper-case letters on a green background) tells that the jam contains fructose. The declaration of contents tells the energy contents, and is printed in black on a golden bac ground. 25 g on the lid is the weight. The semicircular text to the left contains the name of the producer and the address. The symbol at the top is the logotype. The semicircular text to the right requests us to turn the package upside-down, where there is a "best-before date".

Often, a colour picture - a photograph or a realistic drawing - gives an direct information or an association on the contents of the package. The picture is often reinforced with a heading in a large size of type and a clear typeface. There is often a short text describing the characteristics of the article or product. The declaration of contents may be presented as a compact table or a short text. These texts are often set in a small size of type and printed in a colour with little contrast to the background. It always takes much more time to read the text than to read the picture.

Everyday graphics with clear pictures may also work internationally, with people that do not know the language in question. Here, the *context* is very important. The pictures of oranges, strawberries, raspberries, or peaches on individual portions of jam serve as a good guidance of the people who queue at the hotel's breakfast buffet. On several occasions, I have witnessed how people after a quick glance on different packages make their choices. Obviously, just a few eye fixations on a package are enough to tell the contents.

Figure 7. An example of everyday graphics printed directly on the lid on two individual portions from a company in the USA, with strawberry jam and orange marmalade (life-size).

Tempting to buy

Often, the purpose of everyday graphics is to tempt consumers to buy a certain product in competition with other, more or less similar and equally good, products. Regarding everyday graphics, the "sender" often has the possibility to turn to experts for help to design the message. Experienced marketing people and publicity experts work closely together to produce verbo-visual messages that function well. The text, pictures, and graphical design of everyday graphics are, therefore, given the final design with great care and consideration.

Everyday graphics may be both aesthetically attractive and decorative. There are also examples of everyday graphics that are not successful. A label or package are often a part of a series: a part of a carefully prepared "whole". Products from one company may be kept together with the help of a common logotype or symbol, and with similar graphical design for the choice of typeface and size of type, the placing of texts, and the use of pictures, colours, and decorative patterns. The intention is that a specific graphical profile will make it easier for the receiver / customer / reader to quickly and easily find articles and products from the same supplier.

Figure 8. Tempting to buy? An exampel of an elegant and free and easy design (left) of a lid on an individual portion of strawberry jam, from a French company (life-size).The semicircular text contains information in several languages on the contents. The three strawberries are printed in colours that look "warmed by the sun" and naturally yellow-orange-red. There is no doubt about the contents or about the trademark.

Figure 9. An example of a less successful design (right) of a lid on an individual portion of strawberry jam, from a Belgian company (life-size).The message "strawberry jam" is clear, but the berries do not look appetizing enough. The colours are not successful. The trademark is very dominating.

Text, picture, and background

Within a given area – such as a page in a book, a poster, or a label – the designer may distribute text, picture, and background (margins, space, and patterns and designs without any significant picture elements). A typical page in a telephone directory is almost filled with text. There are no pictures, and the margins are narrow. Here, the text may cover 90 percent of the page. In dictionaries the text covers 75-80 percent, and in specialist books and factual study books the text often covers 50-60 percent of the page. In pure literature and children's books, the text area is often even smaller than that. When a picture covers the entire page, there is no space for text or margins. The third extreme is an empty page.

In order to easily compare the relationship between text area, picture area, and background area in different graphical verbo-visual messages, I have developed a *verbo-visual area diagram.* This diagram has three axes: text area, picture area, and background area. The three axis are graded from zero to 100 percent. The text and picture axis have a common starting-point, and there is a right angel (90 degrees) between them. The background axes is situated at a 45-degree angel to both the other axis, and it is graded from the outside towards the starting point of the other axis. Consequently, where the text and picture areas are zero, 100 percent is background / emptiness.

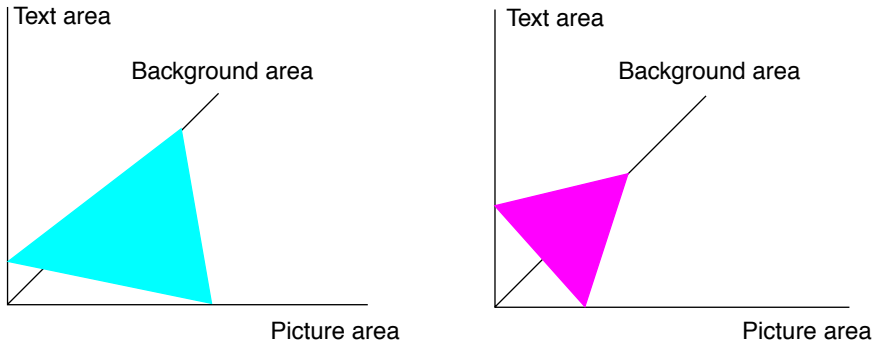

Figure 10. A verbo-visual area diagram on the mean values of the four posters to the left (picture area 68%, text area 15%, background area 17%), and on the mean values of fourteen lids on jam packages to the right(picture area 30%, text area 33%, background area 37%).

The areas for text, picture, and background have been calculated by putting a transparency with a grid over enlarged copies (300 percent) of the everyday graphics, and over reduced copies of the posters. By counting the number of squares for each category, the percentage distribution of text area, picture area, and background area is easily calculated. When text is printed on a picture, the area is equally divided between the two categories. Text logotypes are regarded

as text. Symbols are regarded as pictures. Depending on the shape and size of the lids, the number of squares varied between 180 and 270. For the posters, the number of squares varied between 345 and 450. Consequently, a single square always represents less than a percent of the area – often less than half a percent.

In the artful posters exemplifying this chapter, the picture area strongly dominates the areas for both text and background. This is shown in a very clear way in a verbo-visual area diagram. (See the illustrations on the following two pages.) On the lids of the jam packages there is much more balance between the text area, picture area, and background area . Area diagrams on the mean values of the fourteen information graphics products in this analysis show great correspondence with a page in a book containing the same amount of text, pictures, and background.

However, among the information graphics products that have been studied, there are some examples with a similar distribution of the area as on the posters. We may consider today's everyday graphics as a development of the posters from the turn of the last century. In several respects, the two groups have similar functions, and there are similarities in their designs. A reason for differences in the designs between the two groups may be the great difference between the products to be "sold". Chéret's advertising for aperitif, books, and foodstuff looks more like today's everyday graphics than the posters in this study. Here, the division of the area is very similar to the French package, "Confiture de fraises". Everyday graphics usually have a very good balance between text, picture, and background. It is probably a good idea to employ this balance also in the production of other kinds of information graphics, as well as in the production of learning materials.

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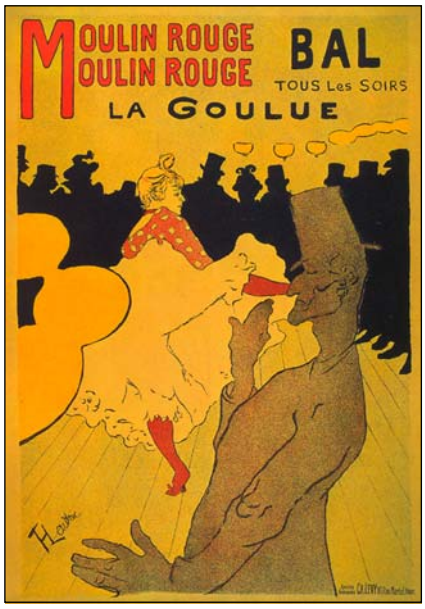

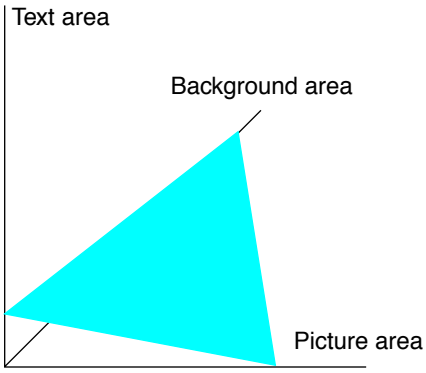

Figure 11. The verbo-visual area diagram for the Moulin Rouge: La Goulue poster has picture area 75%, text area 14%, and background area 10%.

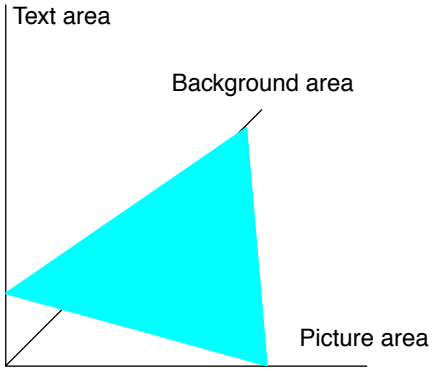

Figure 12. An example of an everyday graphics printed directly on the lid on an individual portion of strawberry jam (life-size). The verbo-visual area diagram has picture area 72%, text area 20%, background area 8%.

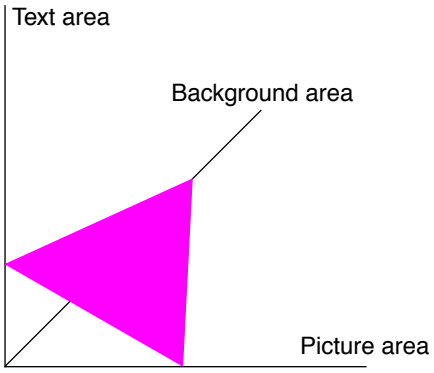

Figure 14. A verbo-visual area diagram for the Dubonnet Aperitif poster, picture area 47%, text area 25%, background area 28%. A typical poster (116 x 83 cm) designed by Jules Chéret, 1895.

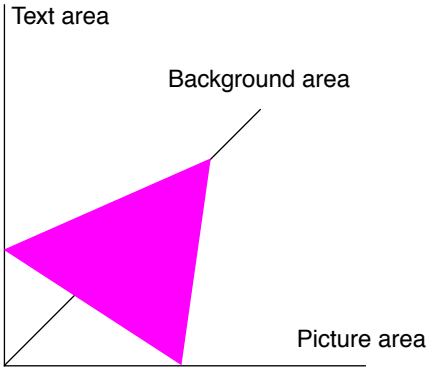

Figure 15. A verbo-visual area diagram on the French everyday StMamet graphic, picture area 47%, text area 33%, background area 20%.

Image manipulation

Abstract. *Concurrent with the rapid development of computers and computer programmes is the growing risk that pictures – particularly photographs – will lose their traditional credibility as it becomes easier to manipulate them as well as our perception of their contents. It is often impossible to see whether a picture is manipulated or authentic. Picture manipulation implies the improper control of people's perception of a given reality through the use of pictures.*

There are pictures almost everywhere. Whether we want it or not, we are constantly confronted with numerous visual impressions. We see pictures in public places, on TV, at the cinema, in books, newspapers and periodicals, on various types of packaging and in many other contexts as well. We have never before had access and been exposed to – or the victims of – as many pictures as exist today. It is obvious, and perhaps a good thing, that all pictures are not salient at every separate occasion. Many actually drown in the general media noise.

Selection of pictures

Different people perceive and describe any given event in different ways. Photographers, journalists, editors and graphic designers may all have different priorities and they may make separate selections. This means that readers and viewers have completely different opportunities to interpret what has actually happened in connection with a given event.

Every published picture has been subject to selection, not just once, but on several occasions before being published in a book, newspaper or any other medium. First the picture creator, the photographer, and/or the artist makes a selection of the subject matter. The photographer makes the initial decision as to how much or how little of a situation will be on the film, tape or memory card. In any given situation a lot of different pictures may be produced. Then the editor, the art director, and/or the designer make a selection among various pictures in a collection or in a picture archive. In instructional materials a picture should never be used just because it is pretty. In information materials every picture should have some information to convey – if it does not, it should be left out. A number of authors have described different methods for the editing

of visuals so as to change their importance and impact. Some important changes, which can be made to a visual prior to publication, should be mentioned (Pettersson, 1993). For example, a picture editor may elect to crop or expand the original picture. Parts of the picture can be deleted, added, altered, moved or changed in shape. The picture can also be enlarged or reduced in size. A colour can be changed, removed or added. The picture's expressiveness can be altered by the choice of repro method etc.

Conscious and perhaps even unconscious deception, falsification and manipulation of pictures – through tampering, biased selection or improper captions – occur rather often, resulting in readers being manipulated, deluded and misled (Pettersson, 2002). Readers are seldom or never able to judge and understand what has happened before or after the moment a photograph was taken. Nor do they know what occurred in proximity to the situation in question.

Views on image manipulation

Students at the department of Information Design at Mälardalen University in Sweden took part in a study regarding their views and opinions on image manipulation during the spring term of year 2000. The students were asked to answer the following five questions.

1. How do you define the concept image manipulation?
2. What media do you think use image manipulation?
3. How common do you think that image manipulation is?
4. What do you think about image manipulation?
5. Can you see if an image is manipulated?

The students wrote their answers on special forms. After registration of participation it was no longer possible to link any opinion to a specific person. A total of 186 subjects took part in the study. This is about half of all the students at the department. Most students are between twenty and thirty years old. The 930 answers to the five questions presented more than 1,300 opinions about image manipulation. In this study it is not possible to distinguish between opinions from female and from male subjects.

Definitions

The answers to the first question ("How do you define the concept image manipulation?") can be divided in categories of descriptions rather than definitions. The students have used 390 verbs or expressions in their descriptions. Most of the descriptions (86%) explain how the "sender" somehow *makes changes* in the

picture. Quite a few descriptions use similar expressions. In some cases synonyms are used. In the second group (14%) some answers describe *"possible objectives"* for the image manipulation. These descriptions therefore represent another perspective on the concept image manipulation than that of the first group. The five most common verbs are change (28%), transform (15%), add (8%), delete (8%), and distort (7%). We may note that some subjects mix up and confuse image and reality. For example four individuals have answered, "Improve reality." They probably mean, "Improve the image of reality."

Media

The answers to the second question ("What media do you think use image manipulation?") were sorted in such a way that similar answers and answers with basically the same contents are put in "media groups". This question resulted in 368 explanatory expressions for media. The most frequent answers include (1) print media (33%), (2) television (19%), and (3) "all" or "most" media with images (19%).

Occurrence

The answers to the third question ("How common do you think that image manipulation is?") were sorted so that similar answers with basically the same contents are put in "types". The subjects provided 186 explanatory answers. Most students (91%) consider image manipulation to be "frequent". A small group (6%) view image manipulation to be "uncommon". A few subjects (3%) do not know that image manipulation may occur or they have no comments.

Opinions

The answers to the fourth question (What do you think about image manipulation?) may be put in five groups:

1. Image manipulation is a good thing. (6%)
2. Image manipulation is acceptable when this is clearly noted. (7%)
3. Sometimes image manipulation is acceptable. (68%)
4. Image manipulation is wrong. (14%)
5. Other views. (6%)

Thus a small portion of the students (14%) view that image manipulation is wrong. However, a clear majority have the view that *image manipulation may be acceptable*. According to many of the answers things like "the context, the specific situation and the objective of the sender" define if image manipulation is acceptable or not.

The students also *accept* image manipulation in some media, such as magazines, when the topic is "fashion, advertising and propaganda". In fact several students *expect* the use of image manipulation in these media. To "improve, simplify and enhance image quality" are also quite acceptable to many of the students in this group.

Does it show?

The fifth question ("Can you see if an image is manipulated?") was used to clarify to what extent students feel that they can see if an image is manipulated or not. The answers from the 186 subjects may be put in three groups:

1. No, and denying answers. (60%)
2. Hesitating answers. (17%)
3. Yes, and affirmative answers. (23%)

Thus most of the subjects believe that they are not able to see if an image is manipulated. However, almost one quarter of the subjects feel that they are able to see if an image is manipulated.

Validity

It may be reasonable to assume that this group of students have the same, or similar, opinions as other groups of students and as the general public regarding the *definition* of image manipulation. This would also be true for opinions about the occurrence of image manipulation in various *media*. However, with respect to opinions about the *occurrence* of image manipulation this group may differ from the general public. It is reasonable to assume that information design students are more aware about image manipulation, and how easy it is done, than other groups of people. This would also be the case for *opinions* as well as if it is possible to see and *detect* if an image is manipulated or not.

Digital image manipulation

Digitally manipulated photographs began to appear in the daily press in the mid-1980s (Alling-Ode and Tubin, 1993; Becker, 1996; Paul, 2000). The introduction of digital pictures and electronic transmission of pictures has had a radical effect on how pictures are dealt with at various stages of production (Pettersson, 2002) as well as on how readers perceive these pictures (Ritchin, 1990). Technical development has fundamentally changed our presumptions concerning credibility in photographs (Pettersson, 2001). Photos need no longer have natural ties to the film-based original (Fetveit, 1997).

Using modern computers and image processing programs, one can, in principle, make any conceivable change in drawings and photographs as well as in moving pictures on film or video from the very moment the photograph is taken until it is published (Paul, 2000). For a person with the necessary skills and access to the right equipment, there are almost no limitations (Hedgecoe, 1994). Thousands of pictures of various standard backgrounds and foregrounds – depicting different types of landscapes, city environments, people, plants, animals, etc. – can be combined to form an endless number of entirely or partly new picture motifs. In this context, naturally, interesting ethical questions arise, which are neither trivial nor in any way easy to answer.

Figure 1. Image manipulation. One of these pictures is digitally manipulated.

Regulations

Modern computer-based graphical systems have a lot of built-in possibilities for manipulating images. However, usually we need permission from the copyright owner, and – from an ethical point of view – also from any person in the picture. It seems that photo manipulation has become a common practice for many graphic designers working in advertising and entertainment. However, in news, information design, and instruction design, readers and viewers expect pictures and images to represent the truth in a correct way.

In Sweden the law relating to photography ceased to be in effect on 1 July 1994, at which point the regulations concerning the right to photographs were subsumed under the copyright laws. Since then the financial as well as the idealistic interests of photographers, authors, draughtsmen, songwriters and other originators of creative works are protected by the copyright law relating to literary and artistic works (Copyright Act, URL, SFS 1960:729).

Since 1 January 1996, artistic works are protected for the originator's entire life plus an additional 70 years. Thus, many works are protected for more than 120-130 years. This protection is international. The economic right implies the sole right of the originator to determine duplication of the work, the making

of copies and presentation of the work in public. For "picture theft" occurring intentionally or through sheer negligence, the penalty is fines or imprisonment for up to two years.

The ethical rules for the press, radio and TV clearly take exception to manipulation or falsification of picture content through trimming, montage or misleading captions (Bildleverantörernas Förening, 1999; Harrie, 1999; Pressens Samarbetsnämnd, 1999). Presenting inauthentic pictures as though they were real documentary material is forbidden. The party purchasing the pictures is responsible for their proper use. Despite these rules, clear violations occur all too often, in Sweden as well as in many other countries.

Photographers and draughtsmen as well as their organisations stipulate in their terms of delivery that published pictures shall be correct. Those purchasing the right to publish the pictures may not use them in a misleading manner. Nor may they make a picture montage or retouch electronically in such a way that the results can mislead or delude the reader or viewer. Today, one does not have the right to change the content of any picture without the express permission of the holder of the right to that picture.

According to Cifuentes, Myers and McIntosh (1998) the Associated Press has adopted photo manipulation guidelines to prevent dishonest reporting (p. 170):

- The content of a photograph will never be changed or manipulated.
- Only the established norms of standard photo printing methods such as burning, dodging, black-and-white toning, and cropping are acceptable.
- Retouching is limited to removal of normal scratches and dust spots.
- Serious consideration must always be given in correcting colour to ensure honest reproduction of the original.
- Cases of abnormal colour or tonality will be clearly stated in the caption.
- Colour adjustment should always be minimal.

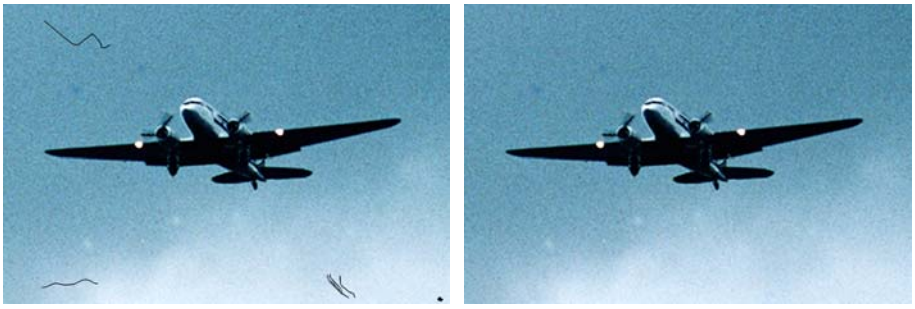

Figure 2. Digital retouching. It is easy to change individual pixels in a picture. These pictures show an old DC-3 flying low over Stockholm. We can easily remove scratches and dust spots and "clean" the picture.

However, sometimes digital photo manipulation, or digital deception, may enhance a message, and sometimes it should be used for better communication. It is possible to modify an image in several different ways. We can change projection, expand, compress, reduce, delete, modify, add, supplement, move, turn, isolate, or combine various parts of an image.

Changing projection

The projection plane can be altered through image modification or shrinkage. This distorts size relationships within the picture and affects our perception of the image contents. It can be used in a creative and positive way to enhance or restore the content of an image. This is easy to experience when using OH-transparencies or slides without a proper set-up of projector and screen.

Expansion and compression

An image can be vertically and/or horizontally *expanded* or *stretched*. This will of course change the size relationships within the image, but may sometimes be necessary. A picture can also be *compressed*, i.e. squashed from the sides or from the top and bottom. Expansion and compression will always result in a more or less serious distortion of the original image. Sometimes this can create useful effects.

Figure 3. This is a photograph from Yellowstone National Park. Tourists are looking at some of the hot springs. We can use positive as well as negative captions to describe any picture. The content in the caption will influence our perception of the picture. Consider the following two alternative captions to this picture:

1. Already in 1872 the authorities managed to preserve a large area in the western part of USA for all people to enjoy. Thus the marvellous Yellowstone National Park is the oldest National Park in the world. This picture shows how easy it is for visitors to access the hot springs and enjoy the wonders of nature. Various minerals create an "artistic" and colourful environment.

2. Already in 1872 the authorities regulated our possibilities to move around at our own will in the western part of USA. This picture shows an area with hot springs in the Yellowstone National Park. The steam has a nasty smell ant it may cause serious illness. It is a very dangerous surrounding. Take a step in the wrong place and you may disappear forever.

Changes and deletions

To focus the reader's attention on the main content in a picture, individual picture elements can be changed so as to improve contrast, acuity, sharpness, grey scale, or colour scale. Surrounding parts can be made paler, darker, or out of focus. The visual's external contour can be blurred and unclear so the picture fades in / out of the background. Good photographers select focusing and depth of field to achieve the same goal – better clarity and better communication. The grey scale can sometimes be transformed into optional colours.

Figure 4. Undesirable parts in a picture can be removed by painting with an appropriate retouching colour. Here the left group of persons are gone. This is easy to do, and it will change our perception of the image content in an improper and unethical way. Now a mother is all alone with her child in a desert-like environment.

Individual picture elements, as well as groups of picture elements, can be *moved* or *turned* around within an image for the sake of better balance and har-

mony. Groups of picture elements can also be copied from one place in an image and moved to one or more other positions within the image. It is also possible to move parts of an image to other pictures.

A picture can be *tilted* on the page at will. Tilting of a picture may draw special attention to it.

Distracting or undesirable details in a picture can be *removed* by painting with an appropriate retouching colour or shade. This is also a way to *isolate* parts of a picture by, say, peeling and cropping. The detail can then be used independently or as a part of other pictures. Deletion can be used for partial silhouetting of a picture so that an important part of the picture pokes beyond the frame. Deletion can also be used for full silhouetting to get rid of all background disturbances. The outline of an image can be softened.

Additions

The relation between width and height of the image can be changed by the addition of space.

Figure 5. Parts in a picture can be added by painting with an appropriate retouching colour or shade. Here a number of new persons are digitally created and added to the image. Now it is almost crowded. The mother is no longer alone with her child. This is easy to do, and it will change our perception of the image content in an improper and unethical way.

To achieve emphasis it is common to add information such as shadows, contrasts, colours, signs, and symbols. Letters of the alphabet, numerals, lines, arrows, circles, and other symbols or markings can be *added* to a picture for the purpose of enhancing image content and focusing attention to specific parts

of the image and links to the legend. The super-imposition of text onto a picture image usually impairs our ability to absorb the contents of both text and picture.

Converting photos

McDougall (1990, p. 32) noted that converting photos to art is a type of photo theft that picture editors should crack down on. It is far to common that artists transform photographs to artwork for use as illustrations in newspapers and books. To transform a photo into a drawing is not only unethical, it is also often an infringement of copyright. McDougall writes: "The courts have held that a work of art which has been copied from another work which is copyrighted, regardless of alterations, is primafacie evidence of copyright infringement. The courts have also held that copying a work of art in a different medium such as changing a photo into a drawing is still a violation." There are, however, examples also of the opposit.

Discussion

Earlier people used to make retouch on photographs using a brush and Indian ink. Today such operations can easily be performed in the computer. However, it is not enough to consider only these kind of surgical changes in pictures as image manipulation. In my view we also need to consider two different types of image manipulation.

1. No change of any picture elements. People's perception of reality can be influenced and steered in a desired direction through well-considered selection of pictures, careful trimming as well as leading captions.
2. Change of certain picture elements in order to influence people's perception of the reality the picture appears to depict.

Based on these distinctions I have proposed the following definition of image manipulation (Pettersson, 2002): "Image manipulation implies the improper control of people's perception of a given reality through the use of pictures." Thus effective use of computers and digital technology for editing and production of good quality pictures do not have to mean image manipulation.

It is obvious that technical development has fundamentally changed conditions for our ability to use pictures in different contexts as well as for the credibility of all pictures. In practice, individual newspaper readers and TV viewers no longer have any real opportunity to discover whether a published picture has been manipulated or not. We can hardly assume that this situation will

improve in the future since computer technology is developing rapidly. With each passing year, it becomes easier for anyone to create and revise pictures, and make them accessible to others on the Internet.

Difficulties, as well as mistakes and deception, exist within news reporting. So far we don't know how to answer the questions: "How can we best 'protect' ourselves from being manipulated by, for example, news reporting? Can we trust the pictures we see? How can we expose deception?" We can, of course, hope that the established media actually assume their responsibility and live up to their own rules. Rules and ethical norms are already in place, but it is evident that all people working in media are not aware of the great responsibility they bear. In the long run this lack of responsibility could lead to a credibility crisis for the news media. If we become accustomed to deception, our trust in the media will diminish.

Good rules and norms, however, are not enough. What is also needed is that people working in media learn them, and that readers and viewers adopt a critical approach to media. To achieve this, pictorial communication, critical analysis and source criticism must become a real and natural feature of teaching in school.

It is conceivable that future generations – growing up with increasingly advanced computers and learning to use them early in life – will develop a freer and more independent approach to pictures and pictorial communication than the one characterising adults of today. Children who learn to work with pictures on computers should find it easier to understand what can be done. When these children are grown, pictures will no longer have any "natural credibility" for them (Pettersson, 2001). They will not expect, for example, that advertisement pictures even attempt to reflect any form of objective reality. At this point, we know little about how pictures function as communicative expressions. There is a great need for research, development work and education regarding the role of pictures.

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Attention

Abstract. *We do not become conscious of all the stimuli detected by our sensory organs. The selective process that controls our awareness of events in the environment is called attention. The process of attention determines which events we become conscious of. Attention may be controlled (1) automatically, (2) by instructions, and (3) by the specific demands of the particular task at hand. The information designer may use various design principles and guidelines in order to facilitate the reader's attention processes, and subsequent processes for understanding and learning.*

In the industrialised, cultural sphere, we are today living in mass-media societies. Every day we are bombarded with information via the media, at home, in school, at work, and in the society in general. It is rather hard to avoid information and it may be just as hard to obtain the information that we really need. Audio, text, and visuals compete for our attention, or mental preparedness and receptiveness. We will miss the information in which we are really interested if we do not attend to it. We direct our attention to what we happen to be interested in; to special sounds; to things that move; are large, bold, and clear; are new; have bright colour, an unusual shape, or a good contrast; and that deviate from the surroundings or from familiar patterns. We direct our attention to contents that arouse feelings and needs.

Pashler (1995) remarked that attention is a common word in ordinary language as well as a name of a field of study. This cause misunderstandings. According to Pashler the concept of attention is part of what might be called a folk-psychological theory – that is, an informal set of propositions people rely on to explain their own and other people's daily experience and behaviour. Most present-day attention researchers work in the tradition sometimes called *information-processing psychology*. Their goal is not to characterise conscious experience per se, but rather to trace the flow of information among different representational systems in the brain. However, the objective for this paper is to provide a ground for design of better information materials. Thus the details of mental information-processing will not be addressed here. The paper provides an "information design perspective" on attention. The information designer may help people to notice the important information. One of the first problems for the information designer is to *gain the attention* of people, and thereafter she or he has the continuing problem of *holding their attention*.

Understanding and learning

In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message – its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements (Pettersson, 1998).

In instructional design and instructional message design the receiver is to (usually) *learn* from the message. However, in communication design and information design the receiver only has to be able to *understand* the message in order to use the information in a practical situation. In many situations this will, of course, also result in learning. But learning is usually not required. Gagné (1977) suggested that *gaining the attention* of the student is the first step in successful instruction. This is also the case in information design. First any information material must *capture attention*. It must be noticed by the intended receivers. Then the message must be comprehended and *understood* by the intended receivers. Further, the content in the message must agree with the receiver's attitudes and beliefs, and motivate them to comply with the directed behaviours.

Complicated language, in texts, pictures and graphic design, will impair the understanding of any intended message. Thus, text and pictures for information should always be designed so that they are easy to read. Any graphical message should be legible, readable, and also well worth reading for the intended audience. Any audial message should be audible, distinct, and also well worth listening to for the intended audience. The goal in information design should be *clarity of communication*. For *learning* to occur we must be mentally prepared to learn. We must be interested and curious. We must be willing to learn! We learn better when we understand the reasons for learning, when we are motivated to learn, and when we work to achieve an important goal.

Learning theories

Understanding and learning are influenced by biological factors, cultural factors, individual prerequisites, psychological factors, social factors, and technical factors. We can distinguish between informal and non-systematic learning by socialisation, and formal learning and systematic learning, in accordance with formal curricula in schooling. According to Dryden and Vos (1994) most of our learning is the result of spontaneous, informal, unconscious learning day after day, week after week, and month after month. It is important to note that only a small part of our knowledge is a direct result of formal education and formal study.

Winne (1995) noted that students often overestimate their possibilities to learn and underestimate the effort that is needed. Learning is affected by the presentation of information. Learning improves when the same information content is presented in different representations: words, pictures, and sound (Paivio, 1983, 1986; Pressley and Miller, 1987). Learning also improves as the quality and depth of the cognitive engagement and processing increases, and declines as the quality of engagement decreases (Dryden and Vos, 1994).

Brien and Eastmond (1994) developed a model explaining learning as a means of attaining one's expectations. To satisfy a particular goal, the individual must pass through intermediate stages or sub-goals. To complete these sub-goals, the person must carry out tasks. If the competence to complete these tasks is lacking, the person must learn and undertake the assembly and the refinement of competencies that permit accomplishment of tasks. Thus, Brien and Eastmond consider competencies as being themselves sub-goals, the attainment of which facilitates the accomplishment of tasks that permit the realisation of goals, and thus the satisfaction of the person's individual needs. They postulated that the affective processes coming into play during the accomplishment of a learning task are the same as those present during the accomplishment of any task in general.

A model for learning or a learning theory may be seen as a codified set of hypothesis about how individuals learn. Some researchers are trying to develop a single comprehensive learning theory encompassing all the different kinds of learning. As far as I know no such attempt has yet been successful. Uljens (1992) noted that there is no theory of learning that is widely accepted, and Kearsly (1999) described fifty different learning theories. Thus we have to deal with a large number of theories and models of learning, and learning processes, each useful in its own context. I prefer to view learning and learning theories from a *process perspective* rather than from a traditional outcome perspective. *Combined learning* is a holistic view of learning, encompassing five categories of learning models. Attention, perception, processing, and application are the basis for the mental model of learning that I call *The Learning Helix* (Pettersson, 1995).

Our senses

Sense organs are the only way that we can record and observe the world outside our own bodies. If we are aware of the limitations of our senses we can make better decisions about the accuracy of what is happening. Natural selection favours qualities that are needed for survival. Thus our senses operates at the level of overt behaviour that enables us to avoid predators, find food, find mates, and move around from one place to another in our environments. Smell, taste, and the sense of feeling are important senses in natural life and often grab and

direct our attention. However, they are not yet especially important factors to be considered when we want to use information conveyed in messages that are distributed with traditional media based on sound and vision.

A great deal of the experimental work during the early years of the twentieth century was devoted to determining the impact of the intensity of a stimulus, such as the loudness of sounds, the brightness of lights, and the strength of pressure, on attentional processes. The duration of a stimulus and the concomitant phenomena of adaptation and fatigue were also studied (Urbina, 1994). We are capable of successfully smelling, tasting, feeling, hearing and seeing things at the same time. We are also capable of simultaneously hearing different stimuli in either ear. However, we are probably incapable of simultaneously perceiving different stimuli aimed at the right and the left eye, respectively. The same kind of stimulus may easily be perceived in different ways at different times.

The part of the eye which sees most clearly (the fovea) is capable of dealing with only a small area at a time. The retina's receptors are excited by light and respond by chemically converting a pigment, rhodopsin (visual purple). This conversion triggers impulses which are transmitted along the optic nerve and the thalamus to the brain's primary visual cortex. This takes only a few milliseconds. In the visual cortex the impulses are translated into a *sensation of vision*.

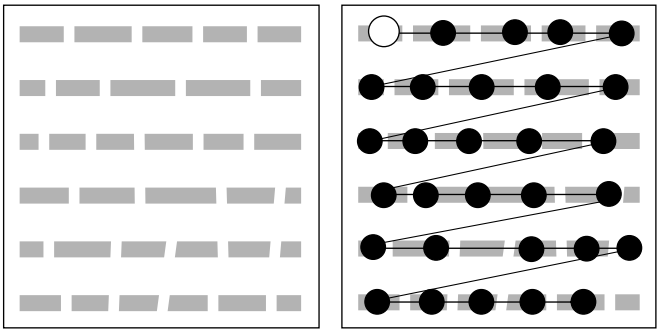

Figure 1. Eye fixations 1. An example of eye fixations on a section of a text. The white circle is the place for the first fixation. We read a text in a structured way with fixations along the lines, not on every word, and not always on the actual words.

Our eyes never remain still. They tremble at a frequency of about 30-90 Hz. This serves to shift information to individual cells. Each eye alters its fixation point constantly. It also makes constant small jumps. We "scan" the things we look at. Fleming and Levie (1978) noted that a general consideration of eye movements is important to the designer's understanding of attention. By using instrumentation that allows the researcher to record exactly *where* a person is looking at any given moment, it is possible to study how the gaze wanders over a picture, pauses and fixes on certain points (see Webb, Matheny and Larson, 1963; Zusne

and Michels, 1964; Guba et al., 1964; Berlyn, 1966; Leckhart, 1966; Gould, 1967, 1973; Yarbus, 1967; Mackworth and Morandi, 1967; Faw and Nunnaly, 1967, 1968; Fleming, 1969; Wolf, 1970; Noton and Stark, 1971a, 1971b; Loftus, 1972, 1976, 1979; Antes, 1974; Hochberg and Brooks, 1978; Baron, 1980; Biederman, 1981; Nesbit, 1981; and Pettersson, 1983).

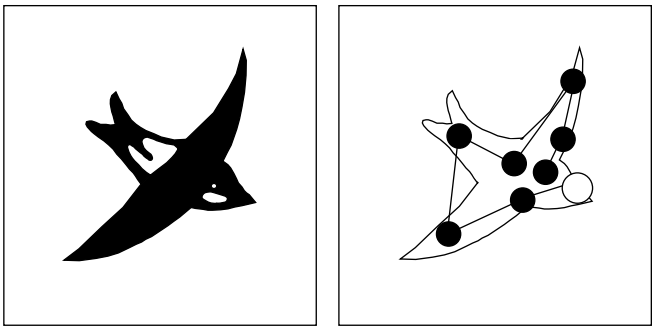

Figure 2. Eye fixations 2. An example of eye fixations on a simple picture. It takes only a few seconds for adult subjects to recognise and "label" the content in a simple picture. Some parts of a picture are never "seen". The white circle is the place for the first fixation.

Reading a text needs to be very structured with several eye fixations on each line. The time for each fixation varies among individuals and different texts (Ekwall, 1977), with the average time for good readers between 1/4 to 1/6 of a second. It also takes from 1/25 to 1/30 of a second for the eye to move from one fixation to the next and sweep from the end of one line to the beginning of the next. In normal reading the text within foveal vision comprises an area of seven to ten letter spaces. Looking at pictures is a "natural" way of free exploring. The gaze never fixes on most parts of a picture. Only certain image elements capture our attention.

Outside of the fovea the number of sensory cells decline. Here the retina is less sensitive. However, these sensory cells are important for our "peripheral vision", which is especially sensitive to movement and brightness, both highly relevant to the detection of any approaching danger.

Dake (1999) argued that our ability to read pictures begins when the eyes scan the visual field and make highly selective choices of spatial information to construct a stable mental image of the world. One study (Zangemeister, Sherman, and Stark, 1995) discovered that non-professional subjects used almost exclusively small, local scans. Professional subjects, however, made many global scans and had a large ratio between local to global scans. Global to local scanning means that we notice the overall structure or figure first, and then the details or informative areas (Printzmetal and Banks, 1977; Navon, 1977; Antes

and Penland, 1981; Biederman, 1981). Thus we quickly find out which details of a picture are the most informative ones, and then we concentrate our attention to those parts. This global to local scanning would seem to indicate that to get maximum impact from a picture, the writer or the presenter should introduce the image content before presenting the actual visual.

A number of scientists have found that pictures which are hard to interpret require more eye fixations than "easy" pictures (Webb et al., 1963; Zusne and Michaels, 1964; Berlyn, 1966; Leckhart, 1966; Faw and Nunnaly, 1967, 1968; Mackworth and Morandi, 1967; Hochberg and Brooks, 1978). Wolf (1970) determined that "difficult" pictures require more fixations up to a certain point. When a picture was extremely difficult, subjects tended to avoid looking at it or searched for a visual centre. However, neither Baron (1980) nor Nesbit (1981) found any correlation between picture type and the number of fixations. But the two latter scientists did employ a different method in their studies than the previously mentioned authors.

Attention

Attention is closely related to the subject of *consciousness* and entails *selecting* parts from all available sensory information, and from memorised information, for further mental processing. The process of attention is the control mechanism that determines which stimuli will be noticed and which will be ignored (Carlson, 1993). Attention determines which events we become conscious of. Attention can be considered as the activation of groups of cells in the brain stem, one of the most primitive regions of the brain. Its functions are correspondingly basic ones – primary control of physiological functions and automatic behaviours that are important to survival, such as drinking, eating, sexual behaviour, and sleeping. Urbina (1994) defined attention (p. 111): "as a readiness on the part of the organism to perceive stimuli that surround it".

Attention is never objective – it is always subjective. We direct our attention to what we happen to be interested in; to special sounds; to things that move; are large, bold, and clear; are new; have bright colour, an unusual shape, a distinct direction, or a good contrast; and that deviate from the surroundings or from familiar patterns. We direct our attention to contents that arouse feelings and needs. Pashler (1995) noted that a task that is given full attention is accomplished quickly and efficiently. Ordinarily attention is under the control of our "will". However, external stimuli that are intense, novel, or significant may sometimes grab our attention and we turn toward the stimulus. If, however, the stimulus is repeated or continuous, the response will diminish. Tasks that initially required full attention may become so automatic that they can later be combined with other activities.

Magicians have learned the production of entertaining illusions. Tufte (1997) noted that magic is to engage in *disinformation design*. Magicians know how to direct the attention of the audience away from their conjuring tricks.

In any given situation there are always far more stimuli than we can ever notice and transfer to the short-term memory. We have to select the data and the information we want to see or hear and we ignore the rest. Most stimuli remain unknown, unseen, and unheard of. For Stern and Robinson (1994) this *selection of sensory data* is the first part of perception. However, many researchers see this selection as attention. Winn (1993) discussed the problem at what point sensory data become information. He wrote (p. 58):

> At what point do sensory data become information? Opinions on this have varied. On the one hand, Gibson (1979) has proposed that information exists in the environment, in the very light that enters our eyes. All humans have to do is pick it up and use it. Others have claimed that nothing can make any sense to us at all until it has been processed, top-down, by conscious attention; even that which we perceive in the first place is determined by what we know and therefore expect to perceive (Neisser, 1976). Recent research suggests a middle ground. While existing knowledge and attentive processing are important for recognition, identification, and so on, a great deal of organizing goes on preattentively. This means that conscious attentional processes are given data to work with that already have an organization that can predispose the perceiver toward particular interpretations.

For the information designer the main concern may be to find ways to influence the audience to really attend to their information materials. The efficacy of the attention process is measured by the advantage that attended tasks have over unattended tasks. It is also measured by the ability to resist distraction.

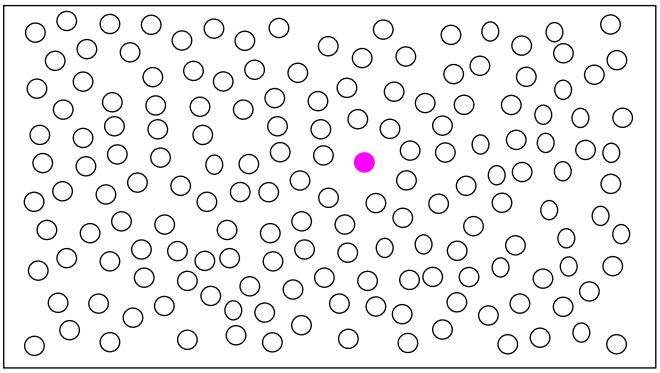

Figure 3. Attention. Among all the different stimuli we only attend to a few. We ignore most of them.

Attention plays an important role in memory. By exerting control over the information that reaches the short-term memory, it determines what information ultimately becomes stored in our *explicit*, or *declarative* memory (Pines, 1986; Carlson, 1993). This is the memory for facts, the memory of which we are aware. We know that we have learned something, and we can discuss this with other people. However, the storage of information in our *implicit*, or *procedural* memory does not require conscious attention. This is the memory for skills. It is our unconscious memory which is capable of controlling rather complex behaviours.

Attention theories

There are several attention models and attention theories. Clements (1984) concluded that "the attentional process is relatively diffuse" (p. 146). Gestalt psychologists, associationists, behaviourists, and psychoanalytic theorists tended to neglect attention in their postulations. Since the mid-1950s, however, there has been a lot of interest in attention. Modern Russian psychologists studied the *orienting reflex* or *orienting response*, which consists of a cluster of physiological changes in the surroundings (Urbina, 1994).

Capacity theories

Broadbent (1958) studied selectivity of attention and he proposed a *filter theory*. According to this theory we are not able to attend to more than one stimulus at a time. Broadbent suggested that while a large amount of sensory information can be absorbed at one time, a selective filter (the attention mechanism) reduces the input from one source while that from another source is being analysed by the brain. Here attention is a limited capacity channel that determines the serial processing of the perceptual system. The filter theory did not allow for the influence of long-term memory or the meaning of the stimulus. However, subsequent experiments showed that the content of an unattended message may be perceived if it is relevant. Semantic characteristics of the stimulus affect attention. Deutsch and Deutsch (1963), and Norman (1967) suggested that we analyse all inputs but only attend to pertinent stimuli.

Resource models

Neisser (1967) outlined a *two-process theory* that made attention a matter of degree. Properties of the stimuli as well as properties of semantic factors play a role in attention. Neisser argued for a constructive view of cognition in which perception is shaped by existing knowledge. Thus attention is influenced by experience and knowledge.

Kahneman (1973) presented a model of attention with *deliberate allocation* of mental resources. In addition to unconscious processes, attention can be consciously focused. One example of this is our sudden attention when you hear someone in a crowd mention your own name. The model also introduced the idea of attention as a skill that can be improved. This skill may be used for improvement of our learning processes.

Eysenck (1982) examined the relationship between attention and *arousal* and concluded that there are two types of arousal: one passive and general system that can raise or lower the overall level of attention, and another specific, compensatory system that allows attention to be focused on certain tasks.

Wickens (1980, 1984, 1991), and Klapp and Netick (1988) suggested a *multiple resource model* of attention and further processing. Resource models based on individually allocated pools of resources have been developed to explain the effects of structural alteration and time sharing that cannot be effectively explained by other attention models.

According to Sweller et al. (1990) all cognitive tasks place demands on a pool of *limited cognitive resources*. When a task imposes a heavy load on the cognitive system, it will in turn interfere with learning by misdirecting attention and limiting remaining resources that are necessary for construction of knowledge

Frames of reference

New impressions are interpreted against the background of our previous experiences and learning, our attitudes and interests, our needs and feelings, and also the prevailing situation.

The attention time span

An *attention span* is the length of time a subject can focus on an object or a topic. Our attention will usually not last for long. Any information material and any presentation must constantly *redraw the attention to hold the interest* of the viewer. A presentation may hold the viewer's attention when the rhythm, layout, and pace are not predictable and boring. Ormrod (1989) pointed out that as children grow, their attention spans grow with them. They can concentrate on tasks for longer periods of time, and can more easily "block out" objects and events that are irrelevant to a task at hand. Young children may chose to pay attention either to a whole picture or to specific parts of it. For children until about nine years of age it might be difficult to switch attention between a part and the whole (Pettersson, 1989).

When people turn on their television set they might not be interested in the programme. In Japan, television-viewing habits were recorded for participants in the Hi-OVIS project (Matsushita, 1988). During the first 30 seconds, people

sometimes switched between 15-20 different channels. Thus, people only spent one to two seconds viewing the television image and deciding if the programme was interesting or not. Viewers did not take the time to actually listen to the sound. Their decisions were based on the pictorial style and the contents. According to Biederman (1995) people can usually interpret the meaning of a novel scene on television from a 100-millisecond exposure to it.

Commissioned by the Director's Guild in honour of its 50th anniversary in 1986, the film *Precious Images* was a gift to the American movie audiences. This short consists of a 6.5-minute assemblage of classic moments from 469 favourite movies. Some moments linger for a few seconds but many are as short as eight frames (1/3 of a second), averaging 20 frames (less than a second). It is a strange experience to see this film. The carefully chosen images retain their meaning and emotional impact, and trigger your memory. However, in my view you need to see the film several times in order to fully appreciate it.

Attention to novelty

Fleming and Levie (1978) and Ormrod (1989) noted that *novelty* and whatever stands in contrast to immediate past experience or to life-long experience grabs our attention. Something unusual will capture our attention almost every time. Attention is not necessarily drawn to the excessively loud, bright, or extraordinary, only to what is quantitatively different from what has been attended to previously. Thus, attention is drawn to changes. Fleming and Levie (1978) argued that in directing our attention, we seek a balance between novelty and familiarity, between complexity and simplicity, between uncertainty and certainty. Familiarity in excess produces boredom, while novelty in excess produces anxiety.

The competition for our attention is usually very fierce in advertising and in propaganda. In accordance with Key (1977), the average adult in the USA was exposed to over 500 advertising messages daily in 1977, of which he or she consciously perceived around 75. Now, there are even more messages. Weilenman (1999) reported that every person in Stockholm, Sweden, is exposed to over 2 000 advertising messages daily in 1999. Here, it was not reported how many messages people actually pay attention to.

Moriarty (1991, p. 5) sees an *advertisement* as a conversation with a customer about a product. "It gets attention, it provides information, it tries to make a point, and it encourages you to buy, try, or do something. It tries to create some kind of response or reaction. It speaks to the heart as well as the head". Advertising is also a form of mass-communication, which is much more complex than a regular conversation.

Advertisements must be designed so that they will be noticed as easily as possible. Therefore, it is important to choose a graphical form that arouses interest. Here, unusual and new typefaces can be useful. In advertising the graphical

form should stimulate attention, entice the reader to look at the pictures and begin reading the text. Since there are over 60,000 different typefaces (with still more being introduced), it is easy to combine them in many ways (Mijksenaar, 1997). Most of these typefaces are, however, limited in their usefulness.

Attention to movement

As previously noted our peripheral vision is especially sensitive to movement and brightness, both highly relevant to the detection of any approaching danger. According to Fleming and Levie (1978) this *preattentive* vision provides a global, holistic view of the visual field in which figures are separated from each other. Movement or change in a picture or in an event attracts our attention and therefore causes many eye fixations. Hubel and Wiesel (1962) found that many sensory cells in vision responded only very weakly to uniform light but very vigorously to changes in light intensity. This principle also applies to other sensory cells, i.e., the cells respond primarily to change. Sensory cells are also quickly exhausted.

There seem to be different degrees of efficiency of attention in different situations. When we look at a multi-image slide and film presentation it is obvious that we only have a limited capacity for attention. As soon as the film starts, our attention is directed towards the movement in the film from the surrounding stills. It is just impossible for viewers not to be influenced by the movement. The fact that one must select information implies that there are limits to the ability to perceive, think, or do several things at once.

Acuity falls rapidly outside of the fovea. However, some information can be processed from peripheral vision. The gist of a picture or of an event can be understood after only a few eye fixations. Gibson (1966), Moray (1970), and many of their successors (e.g., Edwards and Coolkasian, 1974) feel that movements detected in peripheral parts of our visual field automatically cause the eyeball to shift position to permit fixation and full attention of these movements.

Animation is common in several media, like video, computer games and on the Internet. The movement is powerful and attracts our attention (Ormrod, 1989). Thus other information may be totally unseen and lost. The relation of figure to ground is particularly determinative of motion perception, which is highly related to our perception of depth. Perception of motion is influenced by contextual variables.

Attention to colour

It is possible for us to see the difference between several million colour stimuli at simultaneous viewing (Evans, 1974). However, if not being seen simultaneously, the number we can identify is much smaller, maybe 10,000–20,000 (Hård and Sivik, 1981). It has been assumed that our perception of colours is a two-sided phenomenon. The discrimination capability represents our possi-

bility to differentiate a figure from its background. It is strongly influenced by and dependent on contextual variables such as lighting conditions and other surrounding colours. The colour identification capacity makes us capable of interpreting "the quality" of the object we perceive.

Fleming and Levie (1978) noted that in visual displays containing several figures of one colour or one shape, a figure of a different colour or a different shape attracts our attention. Ibison (1952), Rudisill (1952), Dwyer (1971), and Spangenberg (1976) all claim that even if colour is not adding any important information to an image, it may still contribute to better learning because the interest may increase, and learners may pay attention to the image. A black and white picture represents reality in a different way than colour pictures. In black and white, all colours are transformed into values of grey. Hue adds the "colour-dimension". Hue may also act as a formal element in a composition, and direct the attention of the viewer.

However, it should be remembered that colour blindness, or better still "anomalies of colour vision", is a condition in which certain colour discriminations cannot be made. Anomalies of colour vision is much more commonly observed among men than women, with estimates ranging as high as 8–10% of the male population (Hartley, 1987). Only 1% of the female population has anomalous colour vision. The failure to distinguish between red and green is most common. Unfortunately, red and green are quite often used as discriminating colours in symbols and warnings.

Attention to oral communication

Many teachers spend most of their time in the classrooms talking to their classes (Gustafsson, 1980a, 1980b; Sigurgeirsson, 1990; Pettersson et al., 1991; Ferrington, 1994). It appears that teachers generally teach the way they were taught, following the traditional approach to education, providing prepackaged information to students. No doubt, the *lecture method* has been the most common method of instruction in western education for centuries. In its early forms, the lecture method was a practised art form, a form of theatrical performance designed to *grab* and to *hold* the attention of the students. Until the advent of low-cost books, the lecture method was actually the most economical method of transmitting information. However, modern teachers are usually not selected for their lecturing and theatrical skills. Thus the lecture method is under frequent attack.

Cochran (1987) concluded that humans cannot transfer ideas whole and intact from one person to another. Human communication depends upon an interactive series of successive approximations presented in metaphors. She found "languaging" useful in *directing attention* to the actions of people as they share their own ideas, listen to others, or learn from technologically produced

sights and sounds. An oral presentation may consist solely of speech, but this is usually not sufficient for achieving the best possible communications.

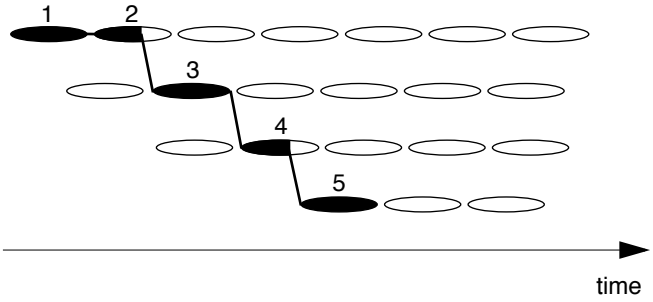

Figure 4. Losing attention. In this model a presenter attracts attention (1), and holds it (2) for a while (black). However, another stimulus (3) grabs the attention of the viewer/listener, who is further distracted (4) by something new. Then it is hard for the presenter to gain the interest of the viewer, who again (5) attend to something else than the presentation. It is easy to loose an audience, and hard to get it back. Unattended stimuli are white in the picture.

Various media may be used in oral communication in order to *improve attention* and perception. Here attention can be appealed to directly through the use of verbal imperatives (look, listen, notice, observe, see) as well as by asking questions and posing problems to the audience. Such guides to learner attention are very useful in increasing the effectiveness of illustrations (Kahneman, 1973).

Attention to printed text

Mayer (1993a) stated that (p. 258-259): "The first cognitive prerequisite for meaningful learning is that the learner pay attention to the relevant information. To accomplish this goal, the text must actually contain potentially relevant information; the instructional designer must successfully employ a procedure for identifying the relevant information; and the instructional designer must effectively draw the learner's attention to the relevant information." So information and instructional designers can make an important contribution.

Readers rarely, if ever, begin at the beginning and read straight through a text all the way to the end. Usually we use a combination of browsing, reading headings, looking at illustrations and legends, reading certain parts carefully, skimming others, and avoiding some parts completely. Keller and Burkman (1993) argued that it is important to create a positive impression and give courseware a comfortable image to *gain* and *maintain* learner attention and to build confidence.

The reading procedure is of great importance to the reader's capacity for understanding a text (Gunnarsson, 1982). In "normal reading", we *direct* our

attention towards how we shall interpret the meaning of a sentence. Studying the syntax becomes subordinate to orienting our thoughts amid the semantic and pragmatic relationships that form the text's warp and woof. Text comprehension is a constructive process, in which the readers build their perception of the whole by integrating the text with their own experiences.

The structure of a text should be as clear as possible. *Internal text structure* is built into the text itself. *External text structure* relates to the embedded strategies which *focus* a learner's attention on particular parts of the text (Jonassen and Kirschener, 1982). Headings should always be relevant and identify the subject matter. The purposes of headings are to attract the attention of the readers, make the subject matter readily apparent, and indicate the relative importance of items. To avoid too large masses of text, it is a good idea to divide the text into sections and subsections. Jonassen (1982) noted that the headings on different hierarchic levels will provide the readers with reference points and help them cognitively organise information for better retention and recall.

Winn (1993) noted that in text, attention is drawn to words or passages that stand in contrast to the rest of the body of the text. To encourage readers to pay attention to relevant information, text designers should help the reader to control his or her cognitive processes during learning (Mayer, 1993b).

Attention to signs and symbols

Any warning, and any symbol, must attract attention and be readily understood by the intended audience, the persons who need the information (Dewar and Arthur, 1999). The message must be legible at the appropriate distance, and must often be legible when seen for a short period of time under bad lighting conditions. A driver on a highway may only have a second or two to read a signpost. Then the message in the warning must be mentally processed and understood correctly. The action to be taken should be immediately obvious. Furthermore the message in the warning must be able to motivate the intended receivers to comply with the desired behaviour (Wogalter, 1999). Here, colour may be combined with shape and position. Complementary colours contrast and provide a warm – cool effect. Colours may have many different meanings. Red, orange and yellow are commonly used in warnings to indicate different levels of hazard (Wogalter, 1999). The choice of colour should also depend on the environment in which the warning is placed (Young, 1991).

Carlson (1993) concluded that studies with visually presented information indicate that attention can focus on *location* or on *shape*. We can pay attention to particular objects or to stimuli that occur in a particular place. This is especially important for those who design warnings and symbols. Irregular and unpredictable shapes dominate basic and regular shapes. Such shapes attract more attention than basic and regular shapes.

Most people can easily perceive the basic shapes, and there is a large degree of perceptual constancy in the perception of shape. *Shape constancy* is our tendency to judge shapes as the same despite changes in distance, viewing angle, and illumination. This is one of the reasons that shapes like the circle, the oval, the triangle, the square, the rectangle, and the rhombus often are used in symbols and icons.

Size constancy is our tendency to judge the size of an object as the same despite changes in distance, viewing angle, and illumination. *Colour constancy* is our tendency to judge the colour of an object as the same despite changes in distance, viewing angle, and illumination.

Attention to pictures

We know that visuals are perceived much more rapidly and readily than text (Fleming and Levie, 1978, 1993; Sinatra, 1986). Lester (1995, p. 73) noted that: "Visual messages are a powerful form of communication because they stimulate both intellectual and emotional responses – they make us think as well as feel." Many authors have suggested various roles, functions, objectives and purposes for the use of illustrations – often without a great deal of evidence to support their suggestions. Pettersson (1999) listed 169 opinions about image functions. More than one hundred different explanatory verbs were used by these researchers to express their opinions. According to scholars in the areas of instructional message design, visual literacy, and visual communication the most common or frequent opinions on functions of visuals concern attention:

- *Attract attention to* a given material or a given subject (Duchastel, 1978; Peters, 1978; Duchastel and Waller, 1979; Holliday, 1980; Heinich, Molenda and Russell, 1982; Levie and Lentz, 1982; Evans, Watson and Willows, 1987; Levin, Anglin and Carney, 1987; Pettersson, 1993; Keller and Burkman, 1993; Wileman, 1993; Lester, 1995).
- *Gain* or *get attention* (Gagné, 1977; Duchastel, 1978; Duchastel and Waller, 1979; Holliday, 1980; Levie and Lentz, 1982; Evans, Watson and Willows, 1987; Levin, Anglin and Carney, 1987; Moriarty, 1991; Leshin, Pollock, and Reigeluth, 1992; Keller and Burkman, 1993; Pettersson, 1993; Wileman, 1993; Lester, 1995).
- *Hold* attention (Levin, Anglin and Carney, 1987)
- *Maintain* attention (Peters, 1978); *maintain* learner attention (Keller and Burkman, 1993).

These opinions may be summarized as (1) *get attention*, and (2) *maintain attention*.

Other common explanatory verbs for image functions are: *facilitate, provide, persuade, create* (an interest in), *illustrate, clarify, motivate, present,* and *reinforce*

information (to someone). Among the students' who took part in the study the most common opinions or purposes are to *visualise, clarify, inform, attract attention, facilitate reading, explain,* and *convey information*.

Faw and Nunnaly (1967, 1968) found that new pictures require more eye fixations than pictures with which subjects were already familiar. When the learner does not see, read, or hear what she or he expects to see, or can not find agreement between verbal and visual content, the message is likely to be misunderstood. We will pay attention to very large and to very small objects that differ in *size*, as well as any object with a special, interesting, or unusual *shape* or unusual *colour* in a picture, and in our surroundings.

Winn (1993) concluded that pictures play many roles in instruction. It is therefore necessary to know precisely what a picture's function is intended to be before it is designed. Cognitive and decorative functions should never be confused or mixed (Pettersson, 1989, 1993). It should be remembered that pictures can have a negative effect on learning. At some point illustrations move from being engaging motivators to engaging distracters (Evans, Watson and Willows, 1987). When too many pictures are used, readers may ignore many of them – the opposite of attention. Massoumian (1989, p. 19) noted that "haphazard use of visuals may lead to minimal or no instructional gain and gradual loss of effectiveness as an instructional tool". In summary, many researchers propose that pictures get and maintain attention of the reader/viewer. However, this is not always the case.

Attention to text and pictures

Vogel, Dickson and Lehman (1986) showed that visual presentation support is persuasive. There is a *picture facilitating effect*. Presentations using visual aids were more persuasive than unaided presentations. At the same time, research in the area of reading indicates that the type of pictures that are used is an important variable in reading comprehension (Levin, Anglin and Carney, 1987). However, unfortunately this becomes less important in reality since most students do not attend to the visuals at all. Many pictures in textbooks obviously remain "unseen" (Reinking, 1986; Weidenmann, 1989; Pettersson, 1990; Peeck, 1993, 1994). Neither teachers, nor students attend to these pictures.

Nelson-Knupfer and Stock-McIsaac (1992) studied the effects of grey shades in instructional materials. Their results indicated that no group of subjects remembered very much of the graphics at all. Along with similar reading speed between the groups, the results supported earlier claims that readers do not really pay attention to visuals used in text.

Hannus (1996) used eye-movement equipment and studied how pupils picked up information while learning from textbooks. He concluded that the learning effects of textbook illustrations are slight because not enough attention

is paid to the illustrations in the books. Thus the learning functions of illustrations were less than he had expected.

In one opinion poll 93 information design students were asked to (1) look at two food packages, and then (2) draw circles on a reply form, with images of the packages, to show were they first had looked at each package. The two packages each displayed four information elements; one pictorial and three verbal:

1. A picture of the contents.
2. The name of the product, a title.
3. The trademark.
4. The amount of contents in the package.

Only one of three subjects (33%) first looked at the pictures on the packages. Two of three (67%) first looked at some verbal information. Most of the 186 observations (42%) were on the name of the product. The trademark was the third group (23%), followed by the amount of contents in the package (2%). I had expected that the pictures should attract more attention.

The *picture facilitating effect* can, however, be increased by making sure that the learners really attend to the pictures.

Attention to graphic design

Graphic design is a tool with which we can manipulate the raw materials – words, empty space, illustrations, colour, paper and ink, and the final number of pages – to achieve the best possible communications between people.

Man has an intuitive sense of balance. When a single element is too large or too small, too light or too dark, too prominent or too indistinct, the entire design will suffer from this imbalance. A visual should usually display the best possible balance. Elements of the visual should fit together in an aesthetic and harmonious relationship in a manner which is interesting but not distracting. Imbalance creates an uncomfortable feeling in the reader and should often be avoided. Inappropriate use of graphical elements may direct learner attention away from essential learning cues and depress subsequent achievement (Pettersson, 1989, 1993).

According to Mullet and Sano (1995, p. 38) the most fundamental design technique is *reduction*. An elegant design must be reduced to its essential elements and each element reduced to its essential form. Good design is simple, bold, and direct. It ensures that significant design elements will be noticed by removing insignificant elements wherever possible. In information design the goal for graphic design should be *clarity of communication*.

The most legible combination is a black text on a light yellow background. For text printed in black all paper surfaces are equally legible if they have a

reflectance of at least 70%. In a normal reading situation black print on white paper is over 10% more efficient than white on black (Pettersson, 1991).

In newspapers and magazines it is quite often a correlation between placement of pictures and perceived importance. The higher up on a page a picture is placed, the more important it is considered to be by several of the readers (White, 1987).

When it comes to general information, the graphical form should basically be simple and "transparent" and *not* arouse any special interest or any attention for its own part. Thus the graphical form should not be too exciting or provocative, nor should it be dull.

We know that common typefaces are easier to read than uncommon typefaces (Tinker, 1963; Benson, 1985). Serif typefaces are often considered to be easier to read than sans serif typefaces, except for small letter sizes (Tinker, 1963). It is also known that running text should be in lower case letters. All-capital printing has been shown to markedly reduce the speed of reading (Poulton and Brown, 1968; Henny, 1981). Lenze (1991) noted that private documents may invite the use of ornate and stylish looking fonts. Professional documents, however, require maximum legibility (Tinker, 1963; Braden, 1983; Benson, 1985). Type can be created in a variety of styles. A change in type style can signal a change of purpose, a new section, or another degree of importance. Typographical techniques can alert learners to such things as main ideas, important concepts, rules, sections, subsections, and more. However, multiple type styles on a page tend to be confusing rather than facilitating. The decision of which font or which fonts to use should rest largely on the purpose and audience of the document (Benson, 1985).

Glynn, Britton, and Tillman (1985) reviewed studies on the effect of "typographic cueing" on learning. Typographic cueing generally refers to the use of **bold type**, *italic type*, or underlining to signal the important ideas in a text. There is little doubt that this kind of cueing does work in drawing attention to the cued material. The consensus is that readers are more likely to remember cued ideas than uncued ideas (Hartley, 1987). Multiple cueing is of little value unless the information is processed in more than one way (Dwyer, 1978). In an experiment with 300 subjects Cisotto and Boscolo (1995) found that the use of paragraph headings improved learning. However, underlining of relevant information did not have the same effect, it did not improve learning. With respect to graphic design of statistical graphics Tufte (1983) concluded that (p. 87):

> Graphical competence demands three quite different skills: the substantive, statistical, and artistic. Yet most graphical work today, particularly in news publications, is under the direction of but a single expertise – the artistic. Allowing artist-illustrators to control the design and content of statistical graphics is almost like allowing typographers to control the

content, style, and editing of prose. Substantive and quantitative expertise must also participate in the design of data graphics, at least if statistical integrity and graphical sophistication are to be achieved.

Later, Tufte argued (1997, p. 48) that good design brings *absolute attention to data*.

Influencing attention

We are almost always paying attention to something, whether it is information in our environment or information already in our heads. Paying attention requires mental effort. Usually we can only attend to one thing at a time. Fleming and Levie (1978) stated that one of the message designer's first problems is to *gain the attention* of the audience, and thereafter she or he has the continuing problem of *holding the attention*. A general attending is often insufficient, for attention must be directed narrowly and precisely to critical aspects of the subject matter. Winn (1993) argued that a great deal of perceptual organisation occurs preattentively, not under cognitive control. The way a message is organised will have an important effect on the way the perceptual system structures what it detects and the perceiver will not be aware of how that information is interpreted.

As previously noted *attention is drawn to changes*. This means that there is a need for creativity and innovation in information design, and a frequent introduction of change into the otherwise repetitive stream of data and information. Fleming and Levie (1978) noted that change and novelty should direct attention to the most relevant ideas in a message rather than to the marginal or superficial content.

Tufte (1990) argued that the principles of information design are universal, and are not tied to unique features of any particular language or culture. As previously noted the goal of communication-oriented message design should always be *clarity of communication*. The message must be accurately developed and transmitted by the sender and then correctly interpreted and understood by the receiver (Pettersson, 1998). Mullet and Sano (1995) noted that (p. 8): "Art is valued for its originality and expressiveness. Its focus is on individual artefacts crafted through the manual and aesthetic virtuosity of the artist. Design, in contrast, is valued for its fitness to a particular user and task."

The sender's creative processes should be influenced by message design principles, and are performed with message design tools suitable for the type of representation that has been selected. Message design principles can be seen as guidelines for design and development of a verbo-visual message. In my opinion the sender should *adapt the verbo-visual message to human attention and to human perception in order to facilitate interpretation, understanding and learning*

(Pettersson, 1997). In general one can state that information should be as simple, clear, and unambiguous as possible. However, in any presentation, information can be enriched with a wealth of details. The following lists provide "attention-oriented" guidelines that may be used in the design of information. Each guideline will improve the possibilities for attention.

Text

- Set text large enough (Ormrod, 1989; Wileman, 1993).
- Set text bold enough (Mayer, 1993a; Wileman, 1993).
- Use headings to make the subject matter readily apparent, and indicate the relative importance of different items in the document (Jonassen, 1982; Mayer, 1993a; Cisotto and Boscolo, 1995).
- Set headings in different type versions to aid comprehension of the text content (Jonassen, 1982; Mayer, 1993a).
- Use space and the actual placement of a heading to enhance the hierarchic structure (Jonassen, 1982).
- Make the key words red or underline them (Fleming and Levie, 1978).
- Use headings, italics, boldface, or a larger font to highlight the relevant information (Mayer, 1993a).
- Do not overuse accenting techniques in text. They may loose their meanings (Bausell and Jenkins 1987; Dwyer, 1978; Hartley, Bartlett, and Branthwaite 1980; Benson, 1985).
- Use white space between portions of a text as a cue to the learners that a new section follows (Waller, 1987).
- Use blinking and flashing text on a computer screen as an accenting technique (Rambally and Rambally, 1987).

Pictures

- Use pictures of the human figure, in particular the face (Goldsmith, 1984).
- Use picture elements that are large enough to see (Wileman, 1993).
- Make the most important part of the subject large and clear (Ormrod, 1989).
- Use picture elements that are bold enough (Wileman, 1993).
- Use several kinds of visual types, such as diagrams, drawings, photos to increase interest in a material (Pettersson, 1989, 1993).
- Pictures must be in colour so they resemble the real world (White, 1987).

Layout

- Instruct the readers to really use the pictures (Reinking, 1986; Weidenmann, 1989; Pettersson, 1990, 1993; Peeck, 1993, 1994; Hannus, 1996).
- Put pictures as close to the relevant text as possible (Lidman and Lund, 1972; MacDonald-Ross, 1977; Hartley and Burnhill, 1977; Haber and Hershenson, 1980; Wright, 1982; Braden, 1983; Benson, 1985; and Pettersson, 1989, 1993).
- Put pictures between the appropriate paragraphs in the text to get maximum impact (Pettersson, 1989, 1993).
- Put pictures on odd-numbered pages. They attract more attention than pictures on even pages (Pettersson, 1989, 1993).
- Use "bleed" (covering the entire page, with no margins) creatively to expand the impact of attention-getting images (White, 1987).
- Tilt a picture in order to draw special attention to it (White, 1987).
- Use bullets, arrows, icons, underlining, margin notes, repetition, and/or white space to highlight the relevant information (Mayer, 1993a).
- Use arrows in order to draw attention to a picture (Lamberski and Dwyer, 1983; Beck 1984).
- Use lines in various colours in order to draw attention to a picture or to specific picture elements (Lamberski and Dwyer, 1983; Beck 1984; Pettersson, 1993).
- Write a legend for each picture (Bernard, 1990; Pettersson, 1993)
- Use legends to direct attention within pictures (Winn, 1993).

Colour

- Use bright and bold colours to capture attention (Ormrod, 1989).
- Use colour as an accenting device (Katzman and Nyenhuis, 1972; Lamberski, 1972; Christ, 1975; Dwyer, 1978; Whiteside and Blohm, 1985; Winn, 1993; Wogalter, 1999).
- Use colour to clarify the structure of a text. Certain parts of the text may be printed with colours or printed on top of backgrounds in different colours (Pettersson, 1989, 1993).
- Consider embedded meanings of different colours when using colours to accent words in a text (Hartley, 1987).
- Use colour and grey scale to influence the perception of size. Open and light forms are perceived as being larger than closed and darker forms of the same shape (Winn, 1993).
- Use colour coding to improve attention. The number of colour codes should be limited and they should always be explained (Pettersson, 1989, 1993).

Balance

- Use the composition to direct the viewers (Wileman, 1993).
- Use imbalance within a picture or within a text (Fleming and Levie, 1978).
- Use unexpected, irregular, and unstable design to attract attention (Fleming and Levie, 1978).
- Provide a good contrast between figure and ground (Wileman, 1993)
- Use combinations of dark and bright, large and small, round and square, to sharpen meaning (Pettersson, 1993).
- Use informal balance to contribute to a feeling of dynamism (Pettersson, 1993).

Emphasis

- A dark dot in a light field and a jog in a line are two examples of emphasis. These contrasts attracts attention. Many different elements in a visual can cause emphasis. Such examples are:
  - Arrows
  - Complexity
  - Contrast
  - Change in size
  - Circles or ovals around objects
  - Colour against no colour
  - Detail against no detail
  - Directionality
  - Exaggerated features
  - Implied motion
  - Isolation
  - Light against dark
  - Line drawings in photos
  - Line intersections
  - Motion
  - Position or placement of elements,
  - Shaded areas
  - Stars
  - Tonal contrast
  - Words in pictures
  - Any other unexpected change or variation out of context will create emphasis, which will attract attention.

  These aids must not be distracting, large, or ugly. Simple styles and fonts are more easily read than complex ones (Pettersson, 1993).

- Use adjunct questions to emphasise relevant information (Mayer, 1993a).

- Use statements of instructional objectives to emphasise relevant information (Mayer, 1993a).
- Box-in important messages to gain special attention (Pettersson, 1989). If the lines are shorter the effect is even more obvious.
- Use arrows or lines in various colours in order to draw attention to a picture or to specific picture elements (Lamberski and Dwyer, 1983; Beck 1984; Pettersson, 1993).
- Use humour as a visual pun to attract attention to the content or dramatise certain portions of a visual. However, humour should be used with great care. Misuse of humour and "funny people" may ruin the intended message. This is sometimes referred to as the "vampire-effect" (Pettersson, 1993).
- Exaggerate the shape of a known person or object, as in caricature or cartoons to draw attention to the whole figure or to particular relevant features of it (Fleming and Levie, 1978).
- Only draw the lines that are necessary to understand the intended content in a picture. Our minds constantly fills in missing details and complete images, most of the time without our realizing that it has happened (Pettersson, 1993).

Warnings

- Use a combination of pictographs and words in complex warning messages (Dewar and Arthur, 1999).
- Use a signal word such as "Danger"; a description of the hazard such as "Shallow water"; a description of the consequences that could occur; the specific actions that should or should not be done, such as "No diving" (Wogalter, 1999).
- Make warning signs of high contrast relative to their background (Barlow and Wogalter, 1993).
- Use large, legible bold-faced alphanumeric characters on warning signs (Wogalter, 1999).
- Put warning signs close to the hazard (Wogalter, 1999).
- Provide warning signs with properties that allow them to be seen in degraded conditions such as low illumination, smoke, or fog (Lerner and Collins, 1983).
- Provide warning signs with adequate reflectance and good lighting (Sanders and McCormick, 1993).

Summary

The process of attention determines which events we become conscious of. Attention may be controlled (1) automatically, (2) by instructions, and (3) by the specific demands of the particular task at hand. A visual material must constantly redraw the attention to hold the interest of the viewer. Our perception varies as a result of a number of factors. Visual information is processed quickly. Seeing is direct and effortless. We do not become conscious of all the stimuli detected by our sensory organs. The selective process that controls our awareness of events in the environment is called *attention*. The information designer may use various design principles and guidelines in order to facilitate the reader's attention processes, and subsequent processes for understanding and learning.

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Interpreting image content

Abstract. *More than 5000 statements from more than 300 subjects show that pictures can generate a great variety of associations in audiences. Different assignments to a picture will influence the meaning in the mind of the viewer. A picture may always be interpreted in different ways. In information design it is not sufficient to choose and use good pictures. Pictures used in information materials always should have captions to guide the understanding of their intended contents*

Image functions

We know that visuals are perceived much more rapidly and readily than text (Fleming and Levie, 1978, 1993; Sinatra, 1986). Lester (1995, p. 73) noted that: "Visual messages are a powerful form of communication because they stimulate both intellectual and emotional responses – they make us think as well as feel." Many papers have suggested various roles, functions, objectives and purposes for the use of illustrations – often without a great deal of evidence to support the suggestions.

Pettersson (1998) presented hundreds of opinions about image functions in communication. More than one hundred different explanatory verbs are used in the literature to express these opinions. According to researchers in the areas of instructional message design, visual literacy, and visual communication the most common opinions on functions of visuals concern *attention*. Attract, gain, get, hold and maintain attention is mentioned by the researchers. Other common explanatory verbs are: *facilitate, provide, persuade, create* (an interest in), *illustrate, clarify, motivate, present,* and *reinforce* information (to someone).

The most common purposes of pictures in the school environment are to: *show, explain, visualize, illustrate, clarify, inform, summarize, convey, mediate, elucidate, present,* and *give* (perceptions), *instruct, describe,* and *entertain*. There seem to be different "fashions" in teaching practice, which differ from culture to culture and may change over time within different cultures. Fashion in the use of educational media is partly related to the technology that is available in that specific culture at that time.

The most common purposes of pictures in information design are to *visualize*, *clarify, inform*, *attract attention*, *facilitate reading*, *explain*, and *convey infor-*

mation. The type of visual to be used in the production of materials for information and learning must often be determined in each case with a view to specific demands on the visual, and also to the prevailing budget and time frameworks.

There are many ways to depict even the simplest object. Many pictures are appropriate to and representative of a given designation, such as Easter, Christmas, flowers, children, horses, dogs, cats, etc. The depiction of, e.g., Jesus Christ and Buddha is commonplace in the classical art of the respective religions. The number of pictures capable of depicting a concept declines as the degree of descriptive detail increases. Many pictures may be regarded as "visual synonyms". A message may always be expressed in different pictures.

We know that the information provider may have many different intentions when they use pictures. However, we do not usually know how people perceive and interpret pictures?

Image interpretation

Some researchers suggest that information is represented solely in the form of propositions. Images are said to be recorded into propositional format by a series of transformations (Pylyshyn, 1973, 1979). Others suggest more complex systems in which a variety of storage formats co-exist in an interlinked manner (Anderson, 1978, 1983; Wender, 1989). The perception process is often assumed to consist of two stages. A fast overview is followed by a conscious analysis. When we first look at an image we only see that which is necessary to perceive and identify objects and events in a reasonable and meaningful manner. This is Gibson's "principle of economy" (Gibson, 1966).

Barry (1998) made a clear distinction between two independent mind systems, one that feels and one that thinks. This explains why images may speak to us holistically and emotionally. Data about some images are only emotionally processed. Other images are analyzed. In rational theory, people weigh things equally and then consciously decide on truth or logic. In reality, however, emotional response comes first. Barry concluded that we begin to respond to the visual environment emotionally, below the level of or rational awareness, *before* we can critically analyze it. This makes it likely that much of cognition is actually rationalization to make unconscious emotional response acceptable to the conscious mind. Pettersson (1987) found that simple line drawings accompanied by various assignments caused different reactions in subjects and presented a similar "dual view". It was obvious that different assignments had caused perception and image interpretation on different cognitive levels.

In comparison to a written text, a visual contains an infinite amount of information. By selecting and utilizing different parts of the information in a picture

on different occasions, we can experience completely new and different perceptions when we re-see a picture in new contexts. Like other languages, pictures consist of coded messages that are comprehensible in a given social context. We often find it difficult to interpret the messages in pictures from unfamiliar cultures and earlier ages.

The reader (viewer) has greater freedom in interpreting a visual message than a verbal message. Extraneous messages may compete with the messages that the sender regards as significant and important. Thus, pictures always incorporate some ambiguity and numerous "correct" interpretations, although not always a picture's intended or anticipated interpretation.

Image associations

Russel (1991) studied how individuals make sense of their world through photographs. A total of 163 children (11 – 12 years old) were given black and white, and colour photographs and were asked to write words and phrases which came to mind as they viewed the images. The picture elicited more than 400 different words / phrases (associations). On average, each child gave a total of 17 words / phrases. Russel concluded that photographs could provide a unique view of life, but the cultural environment and background experiences of the viewer influence the meaning in the mind of the viewer. In making sense of the world through photographs each viewer internalizes the message to personal space, time and life experiences.

Later Russel described five categories for viewers contributions to photographs (Russel, 1993). In *observation* the photograph is seen as a series of observable elements. In *interpretation* the photograph is seen as a stimulus for interpretation. Here the viewer tries to create meaning from the visible elements. In *personal memories* the photograph is seen as a stimulus to recall personal experiences. In *participation* the photograph is seen as a stimulus for imaginative participation. The viewer is participating in the scene in the image. In *medium intrusion* the photograph is seen as a specific communication medium related to the photographer and to the camera.

Pettersson (1994) studied what kind of associations people get from viewing slides and how people interpret pictures in advertisements. In the first study 52 subjects generated 385 associations to six slides. In the second study 50 subjects provided 300 associations to six pictures in advertisements. Both studies showed that pictures could generate a great variety of associations in audiences. It was concluded that *pictures used in information and instructional materials always need captions* to guide the intended understanding of the content. There is often a considerable disparity between the sender's "intended message" and the receiver's "perceived message" (Pettersson, 1985, 1986, 1988). Indeed, it is some-

times doubtful whether the receiver has understood anything at all of what the sender wants to convey. Listeners and readers create their own associations and chains of associations. As far as ambiguous pictures are concerned, there is often a major difference between their denotation, i.e., their literal meaning, and their various connotations, i.e., their associative meanings, and their private associations (Pettersson, 1993, 1994).

Research questions

In order to further observe what kind of interpretations pictures may cause in different people I have designed and conducted another "Image Association Study". The main hypothesis is that *different assignments to a picture will influence the meaning in the mind of the viewer.*

When we ask people a basic question like: "What does this picture represent?" we should expect to get the same answer from different persons in the same cultural environment. This should be an answer on an "immediate level interpretation". At least we should expect to get rather similar answers from different persons. These answers might be rather short and distinct. The same words would be used by a large number of people.

However, when we ask people a question like: "What do you think of when you see this picture?" we should expect to get a large number of different answers. This should be an answer on an "analytic level interpretation". These answers might be rather long and elaborated and subjects would be expected to use many different words.

For this study I formulated the following five questions for our own students at the Department of Information Design at Mälardalen University.

- What does this picture represent?
- What happens in the picture?
- Where did you first look in the picture?
- What do you think of when you see this picture?
- Why do you think so?

The students were also asked to write a caption to each picture. This assignment is not further discussed in this paper.

Research method

To avoid any copyright problems I selected nine of my own photographs from our own ”photo album” to be used in this study. All photographs are highly realistic and they are all in color. The selected photographs represent a range of themes from many different activities and places, and they were randomly assigned a number. These nine pictures could well be used in various information materials and textbooks. The intended image contents are:

The intended image contents are:

1. A group of five lemurs at Skansen, the zoo in Stockholm, Sweden.
2. The Niagara Falls in Canada.
3. A Chinese carnival in Washington DC, USA.
4. A part of Kungsträdgården, a park in central Stockholm.
5. A part of the harbor in Stockholm.
6. Busy traffic in Athens, Greece.
7. An airplane at the airport in Jackson Hole in USA.
8. A dead bird washed up on a sandy Japanese beach.
9. Pont du Gard, an old Roman aqueduct in France.

Figure 1. A group of five lemurs at Skansen, the zoo in Stockholm.

Figure 2. The Niagara falls in Canada.

Figure 3. A Chinese carnival in Washington DC, USA.

Figure 4. A part of Kungsträdgården, a park in central Stockholm.

Figure 5. A part of the harbor in Stockholm.

Figure 6. Busy traffic in Athens, Greece.

Figure 7. An airplane at the airport in Jackson Hole in USA.

Figure 8. A dead bird washed up on a sandy Japanese beach.

Figure 9. Pont du gard, an old Roman aqueduct in France.

The first idea was to show all pictures as slides in class and collect written statements from our student subjects. This would, however, limit the possibilities for individual students to spend the time they felt they needed for each assignment. To avoid this situation we used Internet as a research tool.

All pictures were scanned and made available on a temporary class Web Page on the Internet. The pictures had been numbered at random and had no captions. They were all labeled "Bild x" (where Bild = Picture, and x = 1 – 9). Students taking an introductory course in Information Design were asked to study each picture and answer the above questions on e-mail. The students sent one e-mail for each picture to my research assistant with answers to all the questions. The students were free to spend the time they needed for each assignment. They could easily enlarge the pictures and study various details if they wanted to do so.

The research assistant then opened e-mails from more than 100 students and copy some 4,500 statements into separate word-processing files for each question. The participation of each student was marked in a log. After this moment it is no longer possible to link any statement or opinion to any specific person. The next step in the process was to classify and group the opinions expressed by the subjects.

This method with collection of research data using the Internet worked well. However, since computers build the pictures line by line from the top left corner we had to exclude the third research question from the study. It was not possible to look at the picture in other ways than from the top left corner down to the right.

Results

Data

The following four tables present basic data in this study. The data are discussed in the following sections.

Table 1. What does this picture represent?

Picture	Number of subjects	Number of words	Sum of top five
1	106	723	165
2	100	337	140
3	100	941	136
4	98	732	125
5	97	574	177
6	95	563	95
7	95	626	138
8	92	490	204
9	97	647	118
M	98	626	144

Table 2. What happens in the picture?

Picture	Number of subjects	Number of words	Sum of top five
1	106	957	104
2	100	802	156
3	102	1161	85
4	98	1174	124
5	96	852	133
6	97	902	138
7	95	890	171
8	90	651	114
9	95	895	155
M	98	920	131

Table 3. What do you think of when you see this picture?

Picture	Number of subjects	Number of words	Sum of top five
1	110	846	61
2	98	724	52
3	102	684	35
4	99	530	75
5	96	541	118
6	95	538	52
7	93	644	27
8	92	413	62
9	95	550	61
M	98	608	60

Table 4. Why do you think so?

Picture	Number of subjects	Number of words	Sum of top five
1	105	1370	79
2	97	1089	63
3	99	1105	46
4	99	1175	42
5	98	938	50
6	99	1106	71
7	98	980	50
8	94	1010	73
9	94	965	53
M	98	1082	59

Number of words

Depending on the character of the various assignments subjects have used different number of words in order to express their opinions. These numbers are presented in table 5.

Table 5. Mean number of words in the answers.

Picture	Questions				M
	Q1	Q2	Q3	Q4	
1	6.8	9.0	7.7	13.1	9.2
2	3.4	8.0	7.4	11.2	7.5
3	9.4	11.4	6.7	11.2	9.7
4	7.5	12.0	5.4	11.9	9.2
5	5.9	8.9	5.6	9.6	7.5
6	5.9	9.3	5.7	11.2	8.0
7	6.6	9.4	6.9	10.0	8.2
8	5.3	7.2	4.5	10.7	6.9
9	6.7	9.4	5.8	10.3	8.1
M	6.4	9.4	6.9	11.0	8.4
M1	5.4	8.6	5.8	10.6	7.6
M2	7.6	10.5	6.7	11.6	9.1

Q1 = What does this picture represent? Q2 = What happens in the picture?
Q3 = What do you think of when you see this picture? Q3 = Why do you think so?
M1 = Mean for group 1, pictures 2, 5, 6, 8 and 9.
M2 = Mean for group 2, pictures 1, 3, 4 and 7.

Pictures 1, 3, 4 and 7 form a natural group (group 2). These pictures all include "faces" and they cause more words per answer (M=9.1) than the "technical pictures" in the first group (M=7.6). As we can see from table 5 question 1. "What does this picture represent?" and question 3 "What do you think of when you see this picture?" need a smaller amount of words than question 2 "What happens in the picture?" and question 4 "Why do you think so?".

Answers to the first question are usually focused on the actual image content, while answers to the other questions quite often deal with personal associations caused by looking at the pictures.

Index

In order to be able to compare the diversity of the opinions about the pictures I have calculated a simple index (table 6). This index is calculated as the sum of the five most frequent explanatory words expressed as a percentage of the whole number of words for each picture and each question. High index values indicate that many subjects have the same opinions, expressed by words redundant to the image content. Low index values show that people have many individual opinions expressed with different kind of words.

Table 6. Index.

Picture	Questions				M
	Q1	Q2	Q3	Q4	
1	23	11	7	6	12
2	42	19	7	6	19
3	14	7	5	4	8
4	17	11	14	4	12
5	31	16	22	5	19
6	17	15	10	6	12
7	22	19	4	5	13
8	42	18	15	7	21
9	18	17	11	6	13
M	25	15	11	5	14
M1	30	17	13	6	17
M2	19	12	8	5	11

Q1 = What does this picture represent? Q2 = What happens in the picture?
Q3 = What do you think of when you see this picture? Q3 = Why do you think so?
M1 = Mean for group 1, pictures 2, 5, 6, 8 and 9.
M2 = Mean for group 2, pictures 1, 3, 4 and 7.

As we would expect group 2, the "face group" (M = 11) have lower index values than the "technical pictures" in the first group (M = 17). People are interested in faces. This is known in the literature. Pettersson (1993, p. 225) noted: "Generally speaking, humans, especially their faces, are the kind of content that will get maximum attention in images."

The results clearly show that the first question "What does this picture represent?" has the highest mean index values. It is obvious that pictures 2 (Niagara Falls) and 8 (Dead bird) may contain fewer details of interest to the subjects or details that are confusing to the subjects. The following questions "What happens in the picture?", "What do you think of when you see this picture?" and "Why do you think so?" have a declining level of consistency or an increasing number of individual expressions.

Kinship diagrams

When people express similar views and similar opinions they may sometimes use exactly the same words in the same sentences. However, they may also use synonyms, near synonyms and related words to express what they mean. Some expressions may be different but at the same time express a kind of "kinship" with one another. Thus, from a practical point of view, rather different paragraphs of texts may convey "the same" message.

If all subjects in a study provide exactly the same answer to a question this can be represented in a diagram with one large circle. If all subjects provide their own, individual answer to a question this can be represented in a diagram with one hundred circles evenly distributed in the diagram. I have named this kind of diagram *kinship diagram*.

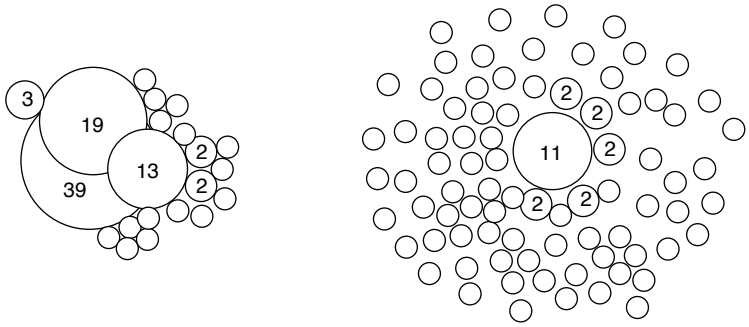

Figure 10. The Niagara Falls (picture 2). The left kinship diagram presents the answers by 100 subjects to the question "What does this picture represent?". The three large circles represents 39, 19 and 13 answers respectively. The diagram to the right presents the answers by 98 subjects to the question "What do you think of when you see this picture?" Here the large circle represents 11 answers. Each one of the small circles represents an answer.

If we put the circle representing the largest number of views and opinions in the centre, then use the direction and distance as variables to subjectively represent the kinship between these opinions it is possible to visually compare results from the different assignments. This is quite possible to do. As we can see from the tables above the index varies a great deal between the various pictures. The first two questions: "What does this picture represent?" and "What happens in the picture?" cause fewer opinions than the following two questions: "What do you think of when you see this picture?" and "Why do you think so?".

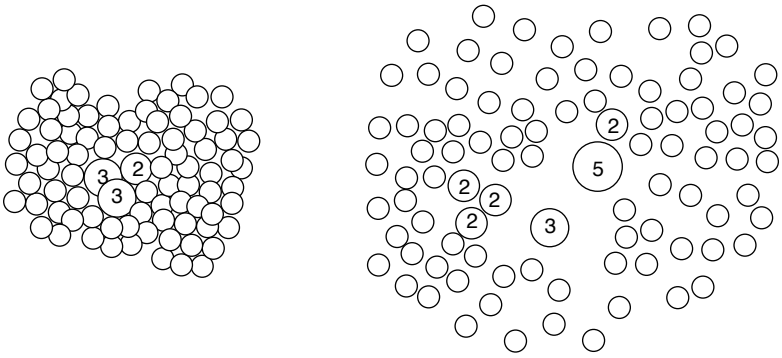

Figure 11. A Chinese carnival (picture 3). The left kinship diagram presents the answers by 100 subjects to the question "What does this picture represent?". The three larger circles represents 3, 3 and 2 answers. The diagram to the right presents the answers by 102 subjects to the question "What do you think of when you see this picture?"

Denotations and connotations

Sometimes it may be quite difficult to decide how an opinion should be classified. Generally speaking it was more difficult to classify pictures with people and the picture with the lemurs than the other pictures. It is obvious to me that different people may do this kind of classification in different ways. However, they will all end up confirming the notion of a *denotation*, i.e., a literal meaning for a picture, and various *connotations*, i.e., associative meanings from that picture, and then also some various *private associations* for each picture.

Table 7. Mean number of denotations, connotations and private associations.

Picture	Questions			
	Q1	Q2	Q3	Q4
Denotations	81	64	24	26
Connotations	13	26	31	33
Private associations	6	10	45	41

Q1 = What does this picture represent? Q2 = What happens in the picture?
Q3 = What do you think of when you see this picture? Q3 = Why do you think so?

When we compare the mean number of denotations, connotations, and private associations for all of the nine pictures it is clear that the opinions expressed are influenced by the assignments. The first two questions "What does this picture represent?" and "What happens in the picture?" have a large number of denotations. The other two questions "What do you think of when you see this picture?" and "Why do you think so?" have a large number of private associations.

Conclusions

More than 5000 statements from more than 300 subjects show that pictures can generate a great variety of associations in audiences. How we actually create meaning is an area where much research still is needed. It may, however, be concluded that:

- Different assignments to a picture will influence the meaning in the mind of the viewer.
- Realistic photographs can generate a great variety of associations in audiences. Visual experience is subject to individual interpretation.
- Humans, especially their faces, are the kind of image content that will get maximum attention.
- Quite often perceived image content is different from intended image content.
- In information design it is not sufficient merely to choose and use good pictures. Pictures used in information and instructional materials always should have captions to guide the understanding of their intended content.

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Learning from visuals

Abstract. *A visual material must constantly redraw the attention to hold the interest of the viewer. Our perception varies as a result of a number of factors. Visual information is processed quickly. Seeing is direct and effortless. Pictures reinforce our knowledge when there is a need for them. Making and understanding visual messages is natural to a point. The ability to read and understand pictures is learned. We must acquire visual literacy skills.*

Introduction

Every day we are bombarded with information via the media: at home, in school, and at work. It is hard to avoid information, and it is just as hard to obtain the information that we really need. Most of the time, audio, text, and visuals compete for our attention. It is possible that we miss the information that we are interested in. We always have a "frame of reference". New impressions are dependent on and interpreted against the background of our previous experience and learning, our attitudes and interests, our needs and feelings, and the prevailing situation.

Attention to visuals

One of the main reasons to use pictures is to *draw attention to* a specific material (Duchastel, 1978, 1983; Duchastel and Waller, 1979; Holliday, 1980; Levin, 1981; Levie and Lentz, 1982; Levin, Anglin, and Carney, 1987; Evans, Watson, and Willows, 1987; Pettersson, 1993). Attention is always subjective. We direct our attention to things that move, are large, bold, and clear, have bright color, an unusual shape, or a good contrast that deviate from the surroundings or from familiar patterns, to what we happen to be interested in at the moment, and to content that arouse feelings and needs. These factors are frequently used in advertising and propaganda. Keates (1982) noted that discriminatory responses to map symbols depend on contrast in form, dimension, and color. In the torrent of information that bombards us, we have to *select* the information we want to see or hear and we ignore the rest of the information. Stern and Robinson (1994)

see "selection" of sensory data as the first step of perception. However, "selection of data" may also be seen as a part of "attention".

When we attend to something, we select that information for further mental processing. In view of our limited capacity for handling simultaneous information (Miller, 1956), it is important to find out which factors determine the parts of the available information that will be processed. Which stimuli do we select and why? When we first look at a visual, we only see what is necessary to perceive. We identify objects and events in a reasonable and meaningful manner. This is Gibson's "principle of economy" (Gibson, 1966). All cognitive tasks place demands on a pool of limited cognitive resources. When a task imposes a heavy load on the cognitive system, it will in turn interfere with learning by misdirecting attention and limiting the remaining resources that are necessary for construction of knowledge (Sweller et al. 1990). Clements (1984) concluded that "the attentional process is relatively diffuse" (page 146). Wickens (1980, 1984, 1991), and Klapp and Netick (1988) have suggested a multiple resource model of attention and processing. Resource models based on individually allocated pools of resources have been developed to explain the effects of structural alteration and time sharing that cannot be effectively explained by other attention models, such as structural theories and capacity theories.

Vogel et al. (1986) showed that it is undeniable that visual presentation support is persuasive. Presentations using visual aids were 43% more persuasive than unaided presentations. At the same time, research in the area of reading indicates that the type of visuals that are used is an important variable in reading comprehension (Levin et al. 1987). However, this becomes less important in reality since most students do not attend to the visuals unless they are instructed to do so (Reinking, 1986; Pettersson, 1990). Hannus (1996) used eye-movement equipment and studied how pupils picked up information while learning from textbooks. He concluded that the learning effects of textbook illustrations are slight because not enough attention is paid to the illustrations in the books. Thus the learning functions of illustrations were less than expected.

It may be concluded that our attention will not last for long. A visual material and a presentation must constantly redraw the attention to hold the interest of the viewer. Attention is sometimes seen as the first step of perception.

Perception of visuals

The perception process is often assumed to consist of two stages or levels. Information processing is tentative, fast, rough, and parallel in the first stage (Sinatra, 1986). It comprises all kinds of analyses from physiological to cognitive processes. A number of different properties of a stimulus are identified simultaneously. In many instances, one analysis is sufficient. The second stage of the

information analysis is conscious, demands attention, and it is detailed and sequential. Various hypotheses about a stimulus are weighed against one another, and tested. Information processing is more definite at this level.

Fleming and Levie (1978) noted over 50 principles, and Winn (1993) listed more than 75 principles related to perception. Individuals differ in the ways that they perceive a stimulus. One person may quickly assimilate it. Another may not pay attention at all. Human perception is sensitive to changes in stimulation. We actually perceive *less* than we see and hear, and much information is never used. At the same time, we may perceive *more* than we see and hear. Our brains fill in missing information. Accurate identification can be made from the correct perception of a few parts. If the system arrives at clarity, then clarity serves as a reinforcement. Our perception of any image depends on our previous experience, our mood, other visuals, texts and sound, as well as our personal interests. When we look at a visual, we also "see" different details in the visual on different occasions. Consequently, a highly "saturated", information-packed message may have something new to offer even after having been viewed many times.

Gestalt psychologists view our attempts to establish order as an innate faculty carried out in accordance with certain "laws". We perceptually construct relationships, groupings, objects, and events. We see dots, lines, areas, light, dark, etc., in an organized way. One of the most simple perceptual organizations is that of "figure and ground". Some elements in a visual are selected as the figure, and remaining elements constitute the background. The context in which a visual message is presented has a major impact on the way it is perceived. In my experience, attention is on either the sound *or* on the image when we view a film or a television program. This is even more obvious when we look at a multi-image slide and film presentation. As soon as the film starts, our attention is directed towards the movement in the film, away from the stills. Animation is common in several media, like video, computer games and on the Internet. However, movement is very powerful and attracts our attention. Thus other information may be totally unseen and lost.

Gestalt psychology shows that perceptually the meaning of a picture depends on the relationship between the different parts in the picture. Preble and Preble (1989) noted that "everyday visual perception" is a continuous flow of complex interrelations. In accordance with the "proximity law", we group objects and events on the basis of their proximity to one another. Objects near each other belong together. The eye tends to be attracted to groups rather than to isolates. Thus several authors have recommended that pictures should be put as close to the relevant text as possible (Lidman and Lund, 1972; MacDonald-Ross, 1977; Hartley and Burnhill, 1977; Haber and Hershenson, 1980; Wright, 1982; Braden, 1983; Benson, 1985; Pettersson, 1993; and Mayer et al., 1995).

It may be concluded that our perception varies as a result of a number of factors, such as cultural and social status, the time and stage of our development, mood, experience, memory, and other cognitive processes.

Processing of visuals

In accordance with Gazzaniga (1967), Sperry (1973, 1982), and Sinatra (1986), perception of two- or three-dimensional representations means parallel, simultaneous, holistic, and fast processing ("right brain activity"). We notice the structure first and then the details (Printzmetal and Banks, 1977; Navon, 1977; Antes and Penland, 1981; Biederman, 1981). This is called *global to local scanning*. We quickly find out which details of a picture are the most informative ones, and then we concentrate our attention to those parts. New impressions are processed and interpreted against a "frame of reference"; our previous experience, attitudes and interests. In order to make a match between visual cues and their referents in the learner's cognitive schemata, translation or transforming activities are needed (Salomon, 1979). Lodding (1983) concluded that the image memory and processing capabilities of the human mind are extremely powerful.

Bertoline, Burton, and Wiley (1992) discussed three primary stages of *visual learning*. These steps are: (1) visual cognition, (2) visual production, and (3) visual resolve. *Visual cognition* includes: (1) visual perception, the ability to mentally comprehend visual information; (2) visual memory, the ability to mentally store and retrieve visual information; and (3) visualization, the ability to mentally create and edit visual information. *Visual production* includes (1) externalization, the ability to create and edit visual products throughout a design process; (2) transmission, the ability to communicate information through visual products; and (3) reception, the ability to comprehend responses to visual products. *Visual resolve* includes the ability to comprehend the termination of a design process.

Cohen, Ebeling, and Kulik (1981) made a meta-analysis of 74 studies which compared visual-based instruction with conventional instruction. They found that students learned slightly more from visual-based instruction than from traditional teaching, but there was typically no difference between the two groups in regard to course completion, student attitudes, or the correlation between attitudes and achievement. Visuals are very useful in learning tasks that involve memory. The information received from visuals appears to remain longer in memory than information received from verbal information. Bagget (1989) stated that information obtained visually is more memorable and "bushier" (page 119): "Visual material creates in memory far broader nets of associations for already learned concepts. There are more connections in the memory representation when the input is visual". Kozma (1991) contended that visual sym-

bol systems are better than verbal symbol systems (page 192): "The bushier nature of representations derived from the visual symbol systems are better for building mental models of the situation than are representations based on audio-linguistic information".

Nickerson (1965), Shepard (1967), Standing, Conezio, and Haber (1970), and Paivio (1971), have shown that subjects are capable of accurately identifying previously seen pictures. Haber (1979) felt that our ability to recognize pictures can be described as virtually "perfect." Over a five-day period, Standing (1973) showed subjects 10,000 slides and found that they were able to recognize 83% on a later occasion. According to Potter and Levy (1969), a person only needed to look at a picture for one to two seconds in order to be able to recognize it among other pictures viewed on a subsequent occasion. Brigthouse (1939), Haber and Erdelyi (1967), and Haber (1979) studied how much subjects actually remembered of picture content. Much more time was needed for people to remember pictures than to merely recognize that they had seen them before. Christianson (1990) showed subjects a series of pictures with emotionally charged, neutral, and unusual content. The experiments disclosed that the subjects concentrated their attention on the central aspect of a depicted event, that is, the thing that surprised them when they viewed an emotionally charged or unusual event.

Experiments with pupils in junior schools (Eklund, 1990), in intermediate schools and in junior high schools (Backman, Berg, and Sigurdson, 1988) showed that pupils in Sweden had a very low "pictorial capability". At all levels pupils have large difficulties in interpreting, as well as in expressing picture content. Low "pictorial capability" is largely true also for the teachers, who very often lack both education and training in visual language and in visual communication. This is quite remarkable since the curricula in Sweden both assume and require all teachers to be responsible for teaching about visuals as a means of communication. I agree with Larsson (1991) who wrote (page 105, in translation): "... it is important that all persons involved increase their knowledge of pictures and the function of pictures in textbooks: teachers, pupils, publishers, authors, designers, artists". Gayer (1992) stated that different types of visuals can be of great use in education. She certified that it is a serious deficiency that many teachers have insufficient knowledge of how visuals function. We know that pictures can have a positive, a neutral, or a negative effect on learning (Levin et al., 1987; Sims-Knight, 1992; Winn, 1993; and Rieber, 1994).

It may be concluded that visual information is processed fast. Our ability to recognize pictures is very good. Pictures reinforce our knowledge when there is a need for them. Seeing is direct and effortless. Making and understanding visual messages is natural to a point. The ability to read and understand pictures is learned.

Text and visuals

Jonassen, Campbell, and Davidson (1994) remarked that it would be impossible to imagine an information processing system that would be capable of decoding, and, even less possible be capable of recognizing, a visual stimulus using only the auditory senses and sensory registers. Several researchers have noted that the human processing system is a multi-dimensional system that is capable of processing and using different types of information through specialized processes (Atkinson and Shiffrin, 1968; Baddeley and Hitch, 1974; Baddeley and Lieberman, 1980).

Pictures in prose

By the mid-1970's, it was well-established that children's immediate, factual recall of simple fiction was improved when picture content was completely redundant with prose content (Levin and Lesgold, 1978). Levie and Lentz (1982) summarized the results of 155 experimental comparisons of learning from illustrated versus non-illustrated text. Forty-six of those studies compared learning from illustrated text material versus learning from text alone. The average group score for the illustrated-text groups was 36% better than for text-alone groups. When all of the studies were considered together Levie and Lentz (1982) presented the following nine conclusions (pages 225–226):

1. In normal instructional situations, the addition of pictorial embellishments will not enhance the learning of information in the text.
2. When illustrations provide text-redundant information, learning information in the text that is also shown in pictures will be facilitated.
3. The presence of text-redundant illustrations will neither help nor hinder the learning of information in the text that is not illustrated.
4. Illustrations can help learners understand what they read, can help learners remember what they read, and can perform a variety of other instructional functions.
5. Illustrations can sometimes be used as effective/efficient substitutes for words or as providers of extra linguistic information.
6. Learners may fail to make effective use of complex illustrations unless they are prompted to do so.
7. Illustrations usually enhance learner enjoyment, and they can be used to evoke affective reactions.
8. Illustrations may be somewhat more helpful to poor readers than to good readers.
9. Learner-generated imaginal adjuncts are generally less helpful than provided illustrations.

Levin et al. (1987) discussed different functions of pictures used in prose. According to them, four functions are "text-relevant." These are called (1) representational function, (2) organizational function, (3) interpretational function, and (4) transformational function.

1. Illustrations are *representational* when they serve to reinforce the major narrative events in the text and "tell" the same story, i.e., are redundant with the text. Representational pictures add concreteness to the prose since memory for pictorial materials is better than memory for verbal materials.
2. Illustrations are *organizational* when they provide a framework for a text. They add coherence to the prose since memory for organized materials exceeds memory for unorganized materials.
3. Illustrations are *interpretational* when they clarify passages in the text that are difficult to understand. Interpretational pictures add comprehensibility to the prose since materials that are initially well understood are remembered better than materials that are more poorly understood.
4. Illustrations are *transformational* when prose content is re-coded into concrete form and related in a well-organized context. These pictures provide readers with a systematic means of retrieving the critical information. Transformational illustrations are designed to impact directly on readers' memory.

After a meta-analysis of results from some 100 experiments on functions of pictures used in prose Levin et al. (1987) concluded that all types of text-relevant pictures facilitate learning from reading prose. There was an increasing learning effect from: (1) representational pictures ("moderate"), (2) organizational and interpretational pictures ("moderate to substantial"), and (3) transformational pictures ("substantial"). Levin et al. also concluded that when illustrations are not relevant to the prose content, no prose-learning facilitation is to be expected. On the contrary, there can be a negative effect. Illustrations should not be used only for decoration in learning materials.

The PSE visual learning experiments

A huge body of experiments on learning from visual media exist. However, many of these experiments suffer from severe weaknesses in the experimental designs, in the selection of materials, or in the selection of subjects and their treatment. The main exception from this is the "Program of Systematic Evaluation", PSE. The PSE was initiated in 1965 by Dr. Francis Dwyer at Penn State University, in the USA. Dwyer wanted to identify visual materials effective in facilitating student achievement of different educational objectives. Since 1965,

more than 50,000 high school, college, and adult learners have participated in more than 200 visual research studies.

Results from these studies have been reported by Dwyer several times (1972, 1978, 1982-3, 1985, and 1994). Throughout the studies, continuity was maintained by utilizing the same 2,000 word instructional unit on the human heart. Visuals range from simple line drawings to realistic photographs, in black and white as well as in color. A variety of presentation formats, such as booklets, television, and slide-audiotape presentations have been used. The heart content was selected because of its motivational value, and because it permitted evaluation of different types of educational objectives. Test formats exist in both verbal and visual versions. Students' knowledge of specific facts was measured with a terminology test. An identification test measured students' ability to identify positions of the different parts within the heart. Students' ability to reproduce the parts of the heart in their correct contexts was measured with a drawing test. A comprehension test measured the students' total understanding of the function of the heart. It was found that visual testing is a valid strategy for assessing students' learning from visualized instruction. According to Dwyer (1985) the effectiveness of a *visual learning environment* is primarily dependent on the following factors:

- The amount of realistic detail in the visuals.
- The method of presentation of the visuals.
- Student characteristics, such as intelligence and prior knowledge of the subject matter.
- Educational objectives.
- The technique used to focus student attention on the essential learning characteristics.
- The type of test format (verbal/visual, etc.) used for the test.

The PSE has progressed through three phases. The results substantiate the fact that the human being is a very complex organism and that *the variables which influence learning are extremely complex* (Dwyer, 1994). During the first phase of the PSE the basic conceptual rationale for the program was developed (Dwyer, 1972). In my view it is possible to draw some general conclusions from these early experiments:

- When visual discrimination is needed, pictures are helpful in identifying the various parts of the heart. The use of visuals does not always automatically improve the achievements of the learners. For some objectives text is enough.

- The effectiveness of a visual depends on the medium, on the type of information, and also on the amount of time that learners are permitted to interact with the material.
- All types of visuals are not equally effective. Line drawings are most effective in formats where the learner's study time is limited. More realistic versions of art work, however, may be more effective in formats where unlimited study time is allowed.
- The realism continuum is not an effective predictor of learning efficiency for all types of educational objectives. An increase in the amount of realistic detail will not produce a corresponding increase in learning.
- Increasing the size of illustrations by projecting them does not automatically improve their effectiveness in facilitating the achievement of the learners.
- Aesthetically pleasing visuals may deceive the learners about their instructional value.
- The same visuals are not equally effective for learners in different grade levels, and for learners with different prior knowledge.
- At high school boys and girls learn equally well from visuals when they are used to complement oral instruction.
- For some learners and for some educational objectives, color improves the achievement of the learners. However, in some cases the added cost of color may not be justified.
- Using questions to focus the attention of the learners on the relevant visual learning cues does not improve the instructional potential of the illustrations.

In the second phase (Dwyer, 1978) the research findings emphasize the importance of the interrelatedness of variables (for example the degree of realism, cueing techniques, the level of educational objectives, individual differences, the method of presentation, and the testing format) associated with the effective use of visual materials. In my view, it is also possible to draw some general conclusions from these experiments:

- Visuals designed to complement oral instruction does not always automatically improve the achievement of the learners.
- For certain types of educational objectives and for certain types of learners, oral instruction without visualization is as effective as visualized instruction.
- All types of cueing techniques do not equally facilitate the instructional effectiveness of different types of visual illustrations in oral instruction.

In the third phase (Dwyer, 1994) the main topic of the research focused on how different independent variables may be manipulated and combined to facilitate increased student learning from visualized instruction. Also here it is possible to draw some general conclusions:

- In computer-based instruction achievement is enhanced when embedded cueing strategies are integrated.
- Visuals with varied degrees of realistic detail can be used to reduce differences in the performance of learners with different levels of prior knowledge of the subject matter.
- Pre-program question cueing is more effective than motion and arrows in facilitating student achievement of specific educational objectives.
- Color coding improves attention, learner motivation, and memory.
- Imagery strategies involving network or information chunking are effective in assisting learners to process new information.
- Externally-paced methods of pacing computer-based instruction were more effective in promoting learner achievement than self-paced methods.
- Different rehearsal strategies impact differentially in facilitating student achievement of different educational objectives.
- Learners who are given quality interaction opportunities spend more time on learning, and achieve significantly more on tests measuring specific educational objectives.

According to Dwyer (1994) the Program of Systematic Evaluation will be multi-focused in the future. Dwyer and his associates will continue to explore the instructional effects of intervening variables. Eventually, the PSE will develop prescriptive guidelines for the production of effective visual learning materials.

Oral presentations and visuals

Yarbus (1967) found that instructions given prior to viewing determined what segments of the picture received the most attention. The things we wish to see in a picture have a major impact on the location of eye fixations. Where we look and why we look there determine what we see. Research concerning the effects of verbal as well as visual modalities shows that children pay more attention to visual than to verbal information. Zuckerman et al. (1978) found that children tend to be more accurate in recognizing visual than auditory segments in television commercials. Hayes and Birnbaum (1980) showed pre-school children cartoons in which the audio track either matched or mismatched the visual information. In both cases, children had a higher retention of the visual than of the auditory information. Pezdek and Stevens (1984) found that when children had to choose which of two incompatible channels to process, they preferred the

video channel. The auditory information sustains attention and facilitates comprehension. Pezdek and Hartmann (1983) found that video without sound reduced comprehension among preschool children. Rolandelli et al. (1985) concluded that children used the auditory component of television to direct attention to important visual information, as well as to process auditory, especially verbal, content.

Conclusions

It may be concluded that visual materials constantly must redraw the attention in order to hold the interest of the viewer. Our perception varies as a result of a number of factors. Visual information is processed quickly. Seeing is direct and effortless. However, we must learn to "read pictures" in order to acquire visual literacy skills, the ability to interpret visual messages accurately and to create such messages. Pictures reinforce our knowledge when there is a need for them, when they do better than text.

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Information and knowledge

Abstract. *It is more and more common that industry analysts state that knowledge is the most important production factor. The transition to global markets has caused difficult adjustment problems, as well as development problems, at both organisational, and enterprise levels. The rapid changing economical, technological, social and political conditions have upset previous stable business ideas as well as stable operational ideas. Turning information into corporate knowledge is a business imperative. Information and instruction designers may be important in this process by producing high quality information and learning materials that facilitate learning.*

Basic concepts

The main concepts: (1) information, (2) knowledge, (3) competence, (4) corporate knowledge, and (5) corporate competence that are used in this paper are briefly defined and discussed in this introduction.

Information. The term information is derived from the Latin noun informatio, which means a conception or an idea. Information has therefore long been synonymous with (1) data, details, facts, and intelligence. However, the term information has acquired additional meanings. It may also refer to (2) the import ascribed to specific data. Then information does not arise until the received data, e.g., a text or a picture, are interpreted by the receiver for formation or moulding of the mind.

The term information is also sometimes used for (3) data processed in a computer. Yet another meaning (4) is "an internal structure which regulates processes". The latter meaning is used in computer science and in genetics.

According to *The new Shorter Oxford English Dictionary on Historical Principles* (Brown, 1993, p. 1364) the term information can also be used for (5) a formal written statement or accusation, (6) the action of informing against a person; and (7) the giving of a form or essential character to something; inspiration. The first two definitions (1 and 2) may be applied in this paper. Thus, here information is data, details, facts, and intelligence, and the import ascribed to specific data.

The verb *inform* means to supply or convey information or to provide knowledge of something and is therefore a unidirectional process, e.g., from one person to another. To *communicate* entails interplay between two or more persons.

Knowledge. The term *knowledge* has several meanings. The *Dictionary* in the 1999 *Grolier Multimedia Encyclopedia* lists the following six definitions: (1) The state or fact of knowing. (2) Familiarity, awareness, or understanding gained through experience and study. (3) The sum or range of what has been perceived, discovered, or learned. (4) Learning; erudition: teachers of great knowledge. (5) Specific information about something. and (6) Carnal knowledge.

Four of these definitions (1, 2, 3 and 5) may be applied in this paper. Also the verb *know* has a number of meanings: *v. tr.* (1) To perceive directly; grasp in the mind with clarity or certainty. (2) To regard as true beyond doubt. (3) To have a practical understanding of, as through experience; be skilled in. (4) To have fixed in the mind. (5) To have experience of. (6a) To perceive as familiar; recognize. (6b) To be acquainted with. (7) To be able to distinguish; recognize as distinct. (8) To discern the character or nature of, and (9) Archaic. "To have sexual intercourse with". As *v. intr.* (1) To possess knowledge, understanding, or information. (2) To be cognizant or aware. Except for (9) all the meanings seem to be more or less applicable here.

The success of businesses in an increasingly competitive marketplace depends critically on the quality of knowledge of diverse areas including raw materials, planning, manufacturing and distribution. Product development requires knowledge of consumer requirements, marketing, science, and technology.

It is, however, not enough to have access to important information and possess the right knowledge. Staff members in any organisation need to have relevant *competence*.

Competence. There are many opinions about what competence is. Stockfelt (1987) argued that competence is a result of (1) having the necessary knowledge at the right time, and (2) being willing to use it. From my own experience I would like to add a third factor. It is also important to (3) be allowed by management to actually use the necessary knowledge.

For Swieringa and Wierdsma (1992) competence is learning which corresponds to the goals of the individual learner. Ellström (1996) regarded competence as the ability of the individual worker to do his or her work. Ellström discussed four parts of the concept competence: (1) knowledge and intellectual abilities, (2) perceptual and manual skills, (3) social skills, and (4) attitudes and factors related to personality. Ekman (1998) discussed three kinds of competence: (1) vocational or professional competence, (2) social competence, and (3) learning competence. Ekman defined competence as the knowledge and the experience of the individual as well as his or her ability to use these in the work situation in interplay with the goals for the business.

The *Dictionary* in the 1999 *Grolier Multimedia Encyclopedia* lists the following definitions of the term competence: (1a) The state of quality of being adequately or well qualified. (1b) A specific range of skill, knowledge, or ability. (2) Law. The quality or condition of being legally qualified to perform an art. (3) Sufficient means for a comfortable existence. (4) Microbiology. The ability of bacteria to be genetically transformable. (5) Medicine. The ability to respond immunbiologically to antigenetic agents. The first two definitions (1a and 1b) may be applied when we discuss the process of turning information into corporate knowledge.

Corporate knowledge. Obviously, an organisation can only learn because its individual members learn. Corporate knowledge can not exist outside of the heads of the corporate staff. According to Juechter (1993), the ability to learn faster and more efficiently than the competitor has become a new hallmark of a successful organisation. Gaining and keeping a competitive advantage nowadays depends on the knowledge that people in the organisation possess and the work that their knowledge enables them to do within the organisation. Learning at work is a business imperative. Reinhardt (1995) concluded that in the information economy, *knowledge is power*. In my view corporate knowledge is the sum of all the knowledge possessed by all the individuals in the organisation.

Knowledge management involves the identification and analysis of available and required knowledge, and the subsequent planning and control of actions to develop knowledge assets so as to fulfil organisational objectives.

Corporate competence. Swieringa and Wierdsma (1992) noted that *collective learning* is aimed at increasing the *collective competence* of the members of an organisation or parts of an organisation. According to Swieringa and Wierdsma (p. 34): "It must be fairly obvious to anyone that collective competence is more than the sum of individual competencies." Corporate competence may be seen as the same as collective competence. It needs to be learned, and this requires effort and time. Swieringa and Wierdsma concluded that, essentially, learning organisations are not only capable of learning and organisational changes, but also of *learning to learn*. Thus corporate competence may be defined as an ability for an organisation to develop and change.

Teaching

Several educationalists have developed teaching theories and teaching models in order to illustrate the relationships between teachers and students. Basically, each such model is based on an outlook on mankind that encompasses what the human being is, has the capacity to be, and has the possibilities to develop into. Other prerequisites for each teaching model are well thought-out outlooks

on society, on information and on knowledge. *Teaching* can be defined as conveying information to a person in an organised form. *Educating*, *training* and *instructing* can be defined as conveying appropriate information to a person who is to be active in a certain profession. The earliest mental-discipline theories of teaching were based on the premise that the main reason for teaching is not for itself but for what it trains – attitudes, values, skills, and intelligence.

Whereas an individual can learn without a teacher, a person cannot teach without a student. There has been some debate among teachers as to whether teaching also implies learning. Does a student have to learn for teaching to have taken place? This is certainly not always the case. In most situations, students are responsible for their own learning. However, some definitions of teaching now imply that students actually have to learn something as a result of teaching. Dryden and Vos (1994) noted that (p. 222):

> Youngsters are their own best educators, parents their best teachers. Our homes, beaches, forests, playgrounds, zoos, museums and adventure areas are the world's best schools.

Ekman (1998) studied the correlation between manufacturing efficiency and operator competence in advanced manufacturing technology in mechanical engineering companies. He concluded that increased investments in education and competence development did not result in increased operator efficiency.

Traditional schooling is based on the assumption that students will learn when they are placed in specific classrooms and are led by expert teachers. The school and the teachers used to have a monopoly on the transfer of information to students. Today, children, youth as well as adults get information from many different sources, such as books, television programs and the Internet. With respect to learning, teaching, and studying Mellander (1993) wrote (p. 2):

> Actually, learning is only difficult in connection with teaching and studying! Otherwise people seem to learn without much effort. How else could we have assimilated the enormous amount of knowledge that we possess?

Many researchers have concluded that traditional teaching is (1) expensive as well as (2) slow (Robert, 1993; Dryden and Vos, 1994; Reinhardt, 1995). New technologies may make learning more productive (Dwyer, 1993). According to Reinhardt (1995) centralised training in companies is now giving way to distributed *just-in-time learning*. The result of this is increased flexibility, better retention, and lowered costs.

Mellander (1993) stated that the management style of the 1990s is "management by learning". The boss is expected to train and to learn together with his or her subordinates, and thus to share leadership responsibilities with them.

Here, the Japanese concept of continuous improvement (kaizen) may be a crucial factor. Imai (1986) called kaizen the single most important concept in Japanese management. Kaizen may be the key to Japanese competitive success.

It may be concluded that turning information into corporate knowledge, and into corporate competence requires learning, but not necessarily teaching or educating, training or instructing. However, management will have to create *learning opportunities* for the staff members.

Models for learning

Learning is an act of structuring and relating data and information. During mental processing of information, new groups of brain cells are activated and associated to each other (Dryden and Vos, 1994). The brain has 100 billion brain cells (neurones) and 900 billion supporting glia cells. Each neurone may be connected to other brain cells via more than 20,000 structures called synapses. The brain cells communicate with each other by transmitting electrical impulses through this gigantic network, which is constantly changed and adopted to new situations. Old and new information is processed in an attempt to find possible relationships or gestalts. Information is gradually converted into *experience*. Experience is then converted into *knowledge*. Later, knowledge may be converted into *insight*, and eventually into *wisdom*.

Every day, spontaneous learning is a natural part of our lives. Mellander (1993) explained spontaneous learning in the following five steps: (1) attention, (2) information, (3) processing, (4) conclusions, and (5) application. *Attention* makes us receptive to *information*, which we *process* together with prior knowledge, until we arrive at *conclusions* and *understanding*, which we then *apply* and test for confirmation. This series of mental processes is also what film directors, authors, and politicians base their presentations on, in order to capture and hold our attention and to convey their messages to us.

A learning theory or a model for learning may be seen as a codified set of hypothesis about how individuals learn. Some researchers are trying to develop a single comprehensive learning theory encompassing all the different kinds of learning. As far as I know, no such attempt has yet been successful. Uljens (1992) noted that there is no theory of learning that is widely accepted. Thus we have to deal with a large number of theories and models of learning, and learning processes, each useful in its own context. Theorists do not all agree about what learning is and how it comes about. Over the years that scholars have been interested in the process, or rather the processes, of learning, many elaborate theories of learning have been developed and tested. Kearsly (1999) described no less than fifty different learning theories.

For this paper it may be interesting to focus on *social learning theory* and the learning models that can be associated with this category of learning theories (Pettersson, 1995). Thus (1) vicarious learning, (2) situated learning, (3) experiential learning, (4) collective learning, and (5) cognitive apprenticeship may all be naturally related to the theme "turning information into corporate knowledge".

Vicarious learning

The social-learning theory is concerned with human social interaction. It has its origin in behaviourist studies of animal learning. Already the Soviet psychologist Lev Vygotsky stressed that much of what we learn, we *learn from others in a social setting*. The social-learning theory focuses on the behaviour patterns that people develop in response to their specific environments. It stresses the importance of the cognitive processes. Some theoreticians emphasise the role that social processes play in heightening insight, understanding, and conceptual thinking. People develop their capacity for thinking in the mutual exchange of ideas with other people. Bandura (1977) noted the importance of human social interaction (p. 12):

> Virtually all learning phenomena resulting from direct experience occur on a vicarious basis by observing other people's behavior and its consequences for them.

Since people can represent situations symbolically, they are able to foresee the probable consequences of their actions and to alter their behaviour accordingly. We learn behaviour by merely observing what other people do and how they behave in different situations. The social-learning theory stresses the importance of *vicarious learning* or *observational learning* and we observe them getting rewards for engaging in that specific behaviour.

The social learning emphasises the role of *models*. Quite often, members of groups of people adopt the same attitudes, feelings, and emotions. Models may be "real" people, but they may also be persons in movies and in television programmes. A growing number of business experts are beginning to question the saying that "experience is the best teacher". According to leaders in the insurance industry, learning through trial and error is too expensive for them (Robert, 1993). Most successful managers agree that it is easier for people to learn from other people´s experiences and mistakes. *Mentoring* is an important way of building on the collective knowledge of past generations.

Situated learning

Lave (1988) argued that learning normally is a function of the (1) activity, (2) context and (3) culture in which it occurs. Learning is *situated*. Social interaction is a critical component of situated learning – learners become involved in a "community of practice". This contrasts with most classroom learning activities which involve knowledge which is abstract and out of context. In everyday situations, people reason intuitively, based upon their experiences within specific contexts, using a variety of methods to solve problems. According to Winn (1993), situated learning occurs when learners work on authentic tasks, whose execution takes place in a real-world setting. The content of the knowledge that is constructed is defined by the environment where the learning occurs.

Situated learning has mainly been applied in the context of technology-based learning activities for schools that focus on problem-solving skills. During problem solving, knowledge acquisition or learning takes place. Thus, learning appears as an activity that indirectly permits the individual to satisfy fundamental needs and, in turn, to adapt to the environment. Since authentic tasks are often problem based, learners are better able to gauge what they are learning and how to use it (Collins, 1993). They learn, based on first-hand experience, when a particular method or strategy is appropriate in authentic contexts. Learners learn to respond to changes in circumstances that influence their own problem solving.

Brown, Collins, and Duguid (1989) found that knowledge would remain under construction in each new situation, each new experience, and each new activity. Memories often include the context in which the learning took place. When attempting to develop situated learning environments, instruction designers use media to provide rich contexts that reflect their interpretation of the real world. The act of observation intervenes and changes what is being observed. It is not possible to be an objective observer of reality, because our methods of observation interact with the process being observed. We cannot observe reality objectively because we participate in it. So, we can not know exactly why people learn. We do not doubt that they do, only that we can control and predict the process with some degree of certainty.

Perkins (1985) noted that many learners experience problems in utilising the knowledge and the skills acquired via formal learning to their everyday contexts. Often the learning of facts is isolated from the contexts in which these facts actually derive their meaning. In formal education settings, such as traditional classrooms, skills and knowledge are operationalized differently from how they later may be used in one or more real life situations. Choi and Hannafin (1995) found that learners may very well pass their exams but they are unable to apply the same knowledge in everyday life when they actually need the knowledge. Smith and Ragan (1999) pointed out that in situated learning testing should be integrated into the task, not a separate activity.

Experiential learning

The process of active learning and real work experience is sometimes called *experiential learning*. To Rogers (1969) experiential learning is equivalent to personal change and growth. The role of the teacher is to *facilitate learning*. Learning is facilitated when it primarily is based upon direct confrontation with practical, social, personal or research problems. Rogers noted that significant learning takes place when the subject matter is relevant to the personal interests of the learner. He also noted that learning proceeds faster when the threat to the self is low.

One of the learning theories that has captured a lot of attention is Kolb's experiential learning theory. According to Kolb (1984), learning is based upon repeated interactions between different cognitive processes and our direct experiences. Kolb developed a model of the styles of learning that people employ when they approach new situations. The learning process is divided in the following four phases: (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation. These four phases are grounded on two dimensions, one is called the "active-reflective" axis, and the other is called the "concrete-abstract" axis. Some years later Kolb, Rubin and Osland (1991) discussed *learning organisations*, and specified four steps, in their continuous development. Their four steps are: (1) reflecting, (2) thinking, (3) deciding, and (4) doing. Reflecting is linked to a period of forming and reflecting on what has happened. Thinking is linked to education. Deciding is linked to consulting, and doing is linked to training.

Learning on demand is a concept for continuing technical education and training at your own workplace. Many large corporations use the public Internet or their own local Intranet as the distribution form, together with existing courses. Intranet is one of the fastest expanding areas in the computer industry. Large companies, like Microsoft, Netscape, Lotus and Sun are creating tools that can be used in a wide variety of new corporate applications, such as *collaborative workgroups* and *intracompany communication*.

Collective learning

There are many situations where we learn from each other, and learn together in *collective learning*, or *co-operative learning*. A collective learning process takes place in and through interaction with and between a number of people. It may be in our leisure hours, or at work. It may be a group of people attending a meeting, or people working together on a special assignment. It is possible to optimise people's situations in groups and organisations, primarily by heightening all individuals' consciousness and deepening their insight into their own situations. The 1990s were sometimes called the "decade of the individual". There

grew, and there is a new kind of respect for the individual. Individual persons, not institutions, are society's driving force.

Co-operative learning is a common classroom practice that enjoys considerable popularity in many schools (Johnson and Johnson, 1989; Sharan, 1980; and Slavin, 1989). Some educational guidelines encourage teachers to use co-operative learning and small-group techniques as a teaching approach (National Council of Teachers of Mathematics, 1989; Science for All Americans, 1989).

Co-operative learning has become an important area in educational technology and in instruction design. This is partly because students often must work together with a limited number of computers (Becker, 1986). However, studies conducted to examine the effect of implementing co-operative learning with computer-assisted instruction have provided mixed results. Some researchers have reported that student achievement increased when co-operative strategies were used (Dalton et al., 1989; Hooper, Temiyakarn and Williams, 1993; and Johnson, Johnson and Stanne, 1985). However, Carrier and Sales (1987) did not find any significant effect for better achievement when learners used co-operative computer-assisted instruction.

Loop-learning

Stockfelt (1987) noted that learning should not be concentrated to specific buildings, or to specific classrooms. In a *learning organisation* learning takes place at work. The learning processes are linked to the work processes. Any work-place may also be a learning situation and any task may likewise be an exercise. The emphasis should be on learning together in teams. And not just within a division, a department or a group, and not only at one level, but also between departments, divisions, and groups and between the different levels in the organisation.

Based upon a "theory of action" Argyris and Schön (1974), Argyris (1976), and Argyris and Schön (1978) discussed a "double loop learning theory". Here, the focus is on solving problems that are complex and ill-structured. It is necessary to change underlying values and assumptions. An important aspect is the distinction between what individuals think and what they actually do. Double loop learning is a theory of personal change that is oriented towards professional education, especially related to leadership in organizations. In double loop learning, assumptions underlying current views are questioned and hypotheses about behaviour tested publicly. The end result of double loop learning should be increased effectiveness in decision-making and better acceptance of failures and mistakes.

Swieringa and Wierdsma (1992) developed the "collective loop-learning theory". Collective learning means *organisational changes*. At the level of single loop-learning this applies to changes in the *rules*, the agreements on how we

collaborate, what we must do or what we are allowed to do within the present system. This may only result in a number of minor improvements. With double loop-learning people bring the shared insights forming the basis of the rules into play. Now people learn new *principles*. This means reasoning, theories and opinions. The double loop-learning may result in renewal of the structure or renewal of the processes in the organisation. The triple loop-learning applies to changes in the communally shared principles on which the organisation is based. It represents collective learning at the level of courage and will, and it results in development and *major changes* of the behaviour of the organisation.

Leymann and Gustavsson (1990) pointed out that group-dynamic learning in organisations can be both positive and negative. It is important to create working environments that are conducive to learning and assignments that give the individual the opportunity to develop his or her own learning capacity. Leontjew (1982) claimed that the situation in the workplace is primarily affected by the tools that are used. The transfer of competence occurs as a result of the *interaction between people*.

The TVI-Method

The further education programme at the Norwegian University of Technology in Trondheim has been very successful. Based on experiences from the TVI-method, *Tutored Video Instruction*, that was developed more than twenty years ago at Stanford University, a method of *team learning* supported by media has been developed.

The TVI-method is based on the common-sense notion that learners can learn more from a lecture if they are free to interrupt it at places where they need more discussion or explanation of a point or a concept (Gibbons, Kincheloe and Down, 1977). The TVI-method supports the communication processes by providing a tutor who acts as a catalyst between the individual learners. In various workplaces in Norway, groups of people engage in this distance education programme. Each team receives video cassettes with recordings from ordinary lectures in the university courses. The members of the teams view these recordings, and interact in various group discussions and group activities. The learners are active and motivated to learn. Hebnes (1995) reported that 90% of the members in three teams (30 persons) preferred this kind of media-supported team learning compared with traditional lectures with ordinary teachers. It was claimed that the factor of success is not the video as such, but the *group interaction*.

The TVI-method has been extended into a TMI-method, *Tutored Media Instruction*, making use of other instructional media such as computer aided instruction and multimedia. The TMI-model provides a very flexible framework for the use of instructional media. It can be adapted towards regional, institutional, content specific, and above all it can effectively be adopted to

learner specific needs, individual learning experiences and various learning styles, previous knowledge, and different cultural backgrounds.

Meta-learning

Mattsson (1995) concluded that it is important to create environments that give employees possibilities to learn by being stimulated as well as allowing for the construction of individual and collective knowledge. In a context of knowledge-intensive industry that is changing continuously, individual and organisational routines are needed to handle both cognitive and organisational imbalance and dramatic changes. When looking only at concrete contextual work, problems often result in limited and short-sighted effects for learning instead of for drastic changes and improvements. Learning is put in focus, since people need to be able to handle changes.

Berg (1993) concluded that in the learning/modular/virtual/ boundary-less/permanently flexible organisations that are being promoted as the best organisational structures for today´s fast-changing environment, *continuous learning* is a critical variable for success. Companies that excel will be those that make full use of their staff's capacity to learn. In accordance with Berg (1993), the ideal employee is a person who loves learning, is flexible, acquires new skills as needed, and is confident enough to devise new rules when the old ones do not work any longer. This is certainly a kind of person with a high competence.

As a society, we place too much faith in collecting facts. Experience suggests that there should be a correct way to do everything; as a result, we waste a great deal of time, money, and energy searching for this mythical right answer. Gathering insight and experience is only helpful if it leads to constructive action. Berg (1993) provided eight steps that organisations and individuals can take to learn the lessons they will need for future success. These steps are:

- Assume nothing.
- Give up the search for right answers.
- Trash your taboos.
- Devote time to learning.
- Reward failure.
- Do not do more of what does not work.
- Do not put people into slots on an organisational chart.
- Reward contribution, not position, longevity, or status.

According to Berg, the future belongs to those who question the past assumptions, constantly innovate, and thrive on change.

As previously noted Swieringa and Wierdsma (1992) concluded that, essentially, learning organisations are not only capable of learning, but also of *learning to learn*. Learning to learn is *meta-learning*. In other words, learning organisations

are not only able to become competent but they are also able to remain competent. The basis for meta-learning is self-knowledge: in particular knowledge about how and why we are learning and why we wish to learn. According to Swieringa and Wierdsma a learning organisation is based on a philosophy in which its members consider themselves and each other as people who have the will and the courage to take on responsibility for their own functioning in relation to other people, and expect the same from them.

Cognitive apprenticeship

Traditionally people have learned to speak, learned to use tools, and learned their crafts by observing and imitating their parents and their masters. When we watch someone carrying out a skill the performance appears to be automatic, confident, consistent, easy, effective, efficient, fast, and smooth. When problems arose in the everyday context of work, apprentices understood the reasons for the problems in a natural way. They asked the necessary questions, and imitated the observed steps to solve the problems. Apprentices acquired their skills through a combination of observation, coaching, and practice. This promoted development of mental models, scaffolding, and gradual self-reliance (Winn, 1993).

Today apprentice settings have been largely replaced by formal education. Now activities often focus on superficial aspects of complex problems. Too little attention is paid to the reasoning and reflective processes, and to the strategies that experts employ when they apply knowledge and perform complex and real-life tasks. In accordance with Collins, Brown and Newman (1989), the *cognitive apprenticeship model* seeks to aid the learner in the construction of knowledge by embedding "the learning of skills and knowledge in their social and functional context" (p. 454). Brown, Collins and Duguid (1989) argued that cognitive apprenticeship supports learning in a domain by enabling learners to acquire, develop and use cognitive tools in authentic domain activity. Learning, both outside and inside school, advances through collaborative social interaction and the social construction of knowledge.

Cognitive apprenticeship focuses specifically on cognitive and meta-cognitive skills. Media can function as powerful tools within a cognitive apprenticeship model, by facilitating the construction of knowledge through the provision of mediated contexts. These contexts may not be fully recreated, only simulated. Cognitive apprenticeship emphasize relationships between the content knowledge and thought processes that experts employ when they perform complex tasks. According to Choi and Hannafin (1995) the "apprenticeship" concept emphasizes the importance of experiential activity in learning, and highlights the inherently context-dependent, situated, and enculturated nature of learning.

The cognitive apprenticeship approach challenges the traditional behaviourist assumption that behaviour can be understood by considering only external or environmental factors. In accordance with cognitivists, intelligence is the ability of an organism to mentally represent aspects of the world and then to operate on those mental representations rather than on the world itself. These mental operations are a kind of mental trial and error. Information is selected from the environment and placed in a temporary buffer, called working memory, and also short-term memory. Once selected, the information is subsequently either discarded or processed more completely. Encoding occurs when new and existing information is integrated in the working memory and then transferred into the long-term memory.

Presentation of information

Turning data and information into corporate knowledge is a business imperative. All members of staff will have to make their contributions to this process. Here information designers may be quite important. Information designers who understand the various learning processes may be able to produce high quality information and learning materials that facilitate learning for various groups of staff. Information designers are able to make complex information easier to understand for the intended receivers (Pettersson, 1998).

Providing a clear structure of a message, providing clarity, simplicity, and unity, securing a high quality of the message, and limiting the total costs are all important *functional principles* in information design. Harmony and proportion are important *aesthetic principles*. Usually a team of people with skills in the different areas are working together. The task is usually too overwhelming for a single person. Art is valued for its originality and expressiveness. Its focus is on individual artifacts crafted through the manual and aesthetic virtuosity of the artist. Design, in contrast, is valued for its fitness to a particular user and to a particular task (Mullet and Sano, 1995, p. 8).

Clarity of communication

Complicated language, in both texts and pictures, will impair the understanding of any intended message. Thus, text and pictures for information should always be designed so that they are easy to read. Any *graphical message* should be (1) legible, (2) readable, and also (3) well worth reading for the intended audience. Good legibility is usually easy to achieve. Any *audial message* should be (1) audible, (2) distinct, and also (3) well worth listening to for the intended audience.

Fleming and Levie (1978, 1993) provided about two hundred "principles" for instructional message design. Here the main focus is on the receiver. These principles are related to the receiver's attention, perception, memory, concept learning, and attitude change. The literature on attention and perception is vast and ranges from fine-grained psycho-physiological work on pre-attentive processes to the more general study of the perception and interpretation of illustration, text, and speech.

Attention is closely related to the subject of consciousness and entails selecting parts from all available sensory information, and from memorised information, for further mental processing. The process of attention is the control mechanism that determines which stimuli will be noticed and which will be ignored (Carlson, 1993). Attention determines which events we become conscious of. Attention may be controlled (1) automatically, (2) by instructions, and (3) by the specific demands of the particular task at hand. Attention can be considered as the activation of groups of cells in the reticular activating system in the brain stem.

Fleming and Levie (1978) stated that one of the message designer's first problems is to *gain the attention* of the audience, and thereafter she or he has the continuing problem of *holding the attention*. A general attending is often insufficient, for attention must be directed narrowly and precisely to critical aspects of the subject matter. Winn (1993) argued that a great deal of perceptual organisation occurs pre-attentively, not under cognitive control. The way a message is organised will have an important effect on the way the perceptual system structures what it detects and the perceiver will not be aware of how that information is interpreted.

The information designer may use various design principles and guidelines in order to facilitate the reader's attention processes, and subsequent processes for understanding and learning. Pettersson (1999) provided more than 50 "attention-oriented" guidelines that may be used in the design of information.

Perception is always organized and it tends to be holistic rather than detail-oriented. We perceptually const-ruct relationships of objects, events, words, and people. We see dots, lines, areas, light, and dark in an organized way. One of the most simple perceptual organizations is that of "figure and background", or simply "figure and ground". Some elements in a picture are selected as the figure, and the remaining elements constitute the back-ground.

The goal in information design and instruction design should always be *clarity of communication*. The message must be accurately developed and transmitted by the sender or information provider and then correctly interpreted and understood by the receiver or interpreter. Then the information designer has succceded.

Learning materials

Learning improves when the same information content is presented in different representations: words, pictures, and sound (Paivio, 1983, 1986; Pressley and Miller, 1987). The representations shall have a redundant or a relevant relationship. Learning improves when the same information is presented in different media. Learning improves as the quality and depth of the cognitive engagement and processing increases, and declines as the quality of engagement decreases. Regular exercise is reported to improve learning (Dryden and Vos, 1994).

When we design information and learning materials, it is very important that the materials are reviewed and approved by people with *expert knowledge* in the appropriate fields. From my own experience it is clear that low quality teaching and learning materials include one or more of the following characteristics:

- The information set provides the wrong information.
- It (the information set) is technically incorrect.
- It is irrelevant for the situation and has "deadwood", information that is not essential or especially supportive in attaining learning goals.
- It does not clearly identify critical prerequisite information and skills.
- It is badly structured and therefore it is hard to understand.
- It is not consistent throughout all its chapters and sections with respect to text, pictures, typography and layout. Thus it is confusing to the reader.
- It has confusing and misleading pictures, not at all relevant to the content of the text.
- It has poor legibility of text and pictures, and therefore it is hard to read.
- It has poor readability of text and pictures, and therefore it is hard to understand.
- It has a writing style that is inconsistent and does not conform to an expected standard.
- It has low reading value, and it is not at all worth reading for the intended audience.
- It is un-grammatical, badly spelt, and incorrectly punctuated.

Unfortunately, all of these situations are quite common today. Using the "wrong" materials means spending extra time and extra money. In a company or in any other organisation the technical departments should be responsible for ensuring that system descriptions, process descriptions, product descriptions, technical reports, course materials, and other documents to be used for learning and training purposes are technically correct and relevant to the situation. The training and competence development departments should be responsible for ensuring that all learning materials are well-structured and

understandable, as well as highly legible and readable, and have a high reading value. The production departments should be responsible for ensuring that, in all learning materials:

- Language and style are used in a consistent fashion.
- The correct terminology is used.
- Typography and layout is correctly used.

The result of every such review should be that a document is either approved or not approved. Documentation that is not technically correct and relevant to the situation must not be used as learning materials or course materials. Such materials should be barred. The documentation must be re-edited, and re-edited again until it receives the appropriate approval.

The aim must always be that the learning materials and other documentation to be used for learning and training purposes receives approval. That is, the legibility, readability, and reading value of the learning materials are approved. It is a good principle in the production of information and learning materials to spend enough time and effort on editing text and pictures for better comprehensibility. As noted in the next section this will often pay back very well in less time used for reading and learning.

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Infodidactics

Abstract. *In this essay I present my personal views on infodidactics, education in information design. My starting point is some general aspects of teaching and learning. Information design has a practical as well as a theoretical component, which influence all studies of the discipline. Then I discuss the multidisciplinary structure and content of message design and information design. One part of the essay deals with the various areas of studies in information design. Finally I present my personal experiences from working with a pedagogical model for teaching information design using a system for distance learning.*

Education

From time to time new areas of knowledge emerge. At the same time established areas of knowledge become less important. Some areas disappear. There may be many thousands of academic disciplines in the world, there are more than 700 in Sweden. Some areas of knowledge have a practically oriented content, while others are mainly theoretically oriented. However, a number of academic disciplines have a practical as well as a theoretical content.

Academic disciplines

Architecture, dance, economics, education, engineering, fine arts, journalism, medicine, music and theatre, and also information design are all examples of disciplines that have *a practical as well as a theoretical component*. When studying such disciplines it is important for the students to work with theoretical as well as practical assignments.

We may see information design as a "theoretical practice" or a "practical theory." It is a complex area of research and study. Nordegren (2004, p. 23–24) noted that adding a theoretical view to the practice of design is to reflect on the methods, aims and the results of this practice. In order to do a qualified reflection we need concepts both to structure thoughts and describe them verbally.

When we understand a subject matter we are able to explain phenomena and predict new phenomena. Although information design theories frequently refer to descriptive theory and propositions, their main function is to guide the

information designers in how to actually design, present and produce information sets. In order to do this, it is important to work with problem-oriented learning in realistic projects; with existing and true problems, with regular "senders" or "information providers", with actual information materials, and with real "receivers" or "information interpreters" that need the information. This also provides realistic experience with budget and time limits.

In the *New Websters Dictionary and Thesaurus* (Websters, 1991, p. 294) the noun *practice* is defined in the following way: "performance or execution, as opposed to theory; custom or habit; systematic exercise for instruction; training; exercise of a profession." In practical disciplines students need to develop practical experience and vocationally oriented skills and craftsmanship. They need to work with practical exercises and learn how to execute different tasks in the best economical, practical and safe way. This expertise is often referred as "tacit knowing" (Polanyi, 1966) or "tacit knowledge" (Rolf, 1991). Polanyi (1966, p. 4) wrote: "we can know more than we can tell."

The noun *theory* is defined in the following way (p. 392): "supposition put forward to explain something; speculation; exposition of general principles as distinct from practice and execution." In theoretical disciplines students need to develop their theoretical skills. They need to work with theoretical assignments, and exercise their analytical and logical skills.

In an attempt to find possible relationships or gestalts information is processed mentally. Information is gradually converted into experience and insight. Experience and insight are then converted into knowledge. Later, knowledge is converted into skills and attitudes – and eventually into wisdom (Pettersson, 2002).

Teaching

Avgerinou et al (2004) noted that whereas an individual can learn without a teacher, a teacher cannot teach without a student. There is some debate among teachers as to whether teaching necessarily implies learning. Conversely, does learning presuppose teaching? This is certainly not always the case, at least not in higher education. In many situations, students are responsible for their own learning. However, some definitions of teaching now imply that students actually have to learn something as a result of teaching.

Dryden and Vos (1994) noted that the school and the teachers used to have a monopoly on the transfer of information to students. Today, there exist many different sources that serve as "pockets of knowledge" to children, youth and adults.

Mellander (1993) made a bold statement with respect to teaching, studying and learning (p. 2): "Actually, learning is only difficult in connection with teaching and studying! Otherwise people seem to learn without much effort. How

else could we have assimilated the enormous amount of knowledge that we possess?"

Cotton (1995) noted that work on the understanding of science has shown that some teaching leaves school children more confused than they were without science lessons. According to Cotton this research is well documented and it is difficult for science teachers to accept these results.

Dryden and Vos (1994, p. 267) noted that the best systems in the world are programmed to succeed. The world's airlines plan to land their planes with 100% safety every time. A one-in-a-million failure rate would rightly be regarded as a tragedy. The world's top car companies spend a fortune to reduce their manufacturing fault-rates from 2% to 1%. But most school systems actually expect and plan for a reject rate that would send any business bankrupt. Since we have to deal with humans and not machines most current educational systems are programmed to fail a large percentage of students; in some cases up to 50%.

Learning

Dryden and Vos (1994) presented several examples of drastically improved learning. They concluded that a learning revolution will take place outside the traditional classrooms and without traditional teachers. They challenged the idea that traditional classrooms with traditional teaching will remain as the main medium of education. Dryden and Vos argued that most of the learning breakthroughs have already been made. Several breakthroughs have come from able teachers, from business, from sports psychology and coaching techniques, and from research into the human brain. Some come from studies in nutrition, and some from health programmes. Many come from linking communities, schools, and businesses together to re-plan the way ahead.

Learning includes complicated cognitive processes. We know, both from research and experience, that teaching will not automatically result in learning (see Mellander, 1991, 1993; Dryden and Vos, 1994; Cotton 1995a, 1995b for examples and summaries).

A *learning theory* or a model for learning may be seen as a codified set of hypothesis about how individuals learn. Some researchers are trying to develop a single comprehensive learning theory encompassing all the different kinds of learning. As far as I know no such attempt has yet been successful. Uljens (1992) noted that there is no theory of learning that is widely accepted. Thus we have to deal with a large number of theories and models of learning, and learning processes, each useful in its own context. Theorists do not all agree about what learning is. Over the years that scholars have been interested in the processes of learning, many elaborate theories of learning have been developed and tested.

Kearsley (1999) described fifty different learning theories. They are all from the 20th century, and they provide very broad and different views of learning. Personally I prefer to view learning and learning theories from a *process perspective* rather than from the traditional *outcome perspective*. A process perspective (Figure 1) may group learning models in six main categories (Pettersson, 1997).

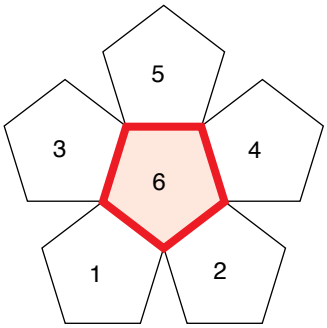

Figure 1. From a process perspective we can see six groups of learning theories: (1) Perceptual motor-skill learning, (2) Associative learning, (3) Learning from analysis and problem solving, (4) Social learning, (5) Learning from representations, and (6) Combined learning.

It is not possible to discuss all of these learning theories nor the six categories here. I will only mention one category – *Combined learning* (Pettersson, 1995). Combined learning is a holistic view of learning, encompassing the other five categories of learning models noted above. We may assume that in many situations several learning processes are involved while we are learning. In my view we may also assume that several learning processes may be active at the same time, sometimes on a subconscious level. When children are playing, it is easy to note their spontaneous learning. Children are active explorers of their environments. They may learn all the time. In fact, we may all learn as long as we live. It is probably not even possible to stop the sensory organs, nor the brain. The sensory organs and the brain work even when we are sleeping. In a normal life situation it is not possible to avoid learning. Most people are curious by nature. However, we are not always aware that we are learning something. Many people have experienced that they have good skills and much knowledge in various areas. Yet they may not be able to explain how, when and why they actually learned these skills.

It is important to have an idea about prerequisites for learning when we plan for teaching of information design. As a teacher it is recommended to plan teaching in such a way that students succeed in their studies and learn practical as well as theoretical aspects of information design.

Message design

A group of design disciplines all deal with the design of messages. This "design family" may be called "message design" (Pettersson, 2002). Message design is an interdisciplinary area of knowledge (Figure 2). It encompasses influences and facts from more than fifty established disciplines and areas of research. The main areas of research and study may be divided into the following six groups with "base disciplines." However, also other groupings are possible.

1. **Language disciplines:** drama, graphic design, linguistics, rhetoric, semiology/semiotics, verbal languages, visual languages and visual literacy. (From a message design perspective the language aspects of graphic design are more important than the art aspects.)
2. **Art and aesthetics disciplines:** aesthetics, computer graphics, film and cinema, iconography, iconology, illustration, and photography.
3. **Information disciplines:** computer science, information processing, and library and information science.
4. **Communication disciplines:** communication theory, education technology, information design, information technology, information theory, instructional design, instructional message design, instructional technology, journalism, media studies, persuasive design, planned communication, television and video.
5. **Behavioural and cognitive disciplines:** cognitive science, didactics, information ergonomics, pedagogy, psychology, sociology and their sub-areas. The study of attention, perception, cognitive skills and memory are especially important. Some aspects deal with individuals, and some with the societies in which we live.
6. **Business and media production technology disciplines:** business economics and management, information economics, information management, law, technologies for production and distribution of different media.

The message design model is a theoretical model showing that different disciplines *influence and contribute* to the area (Figure 2). The model is not intended to show any *exact* relationships between the different groups of the base disciplines, rather subjective approximations. The borders between the areas are therefore blurred and indistinct.

The main components in message design are *words*, *visuals* and *form*. These components may be used in many different ways to produce, transmit and interpret messages of various kinds in different communication situations. Depending on the different objectives with the messages we can see five different "message design groups", or "subject matter groups", of which all are used for communication purposes. These groups are graphic design, mass design, persuasion design, instruction design and information design.

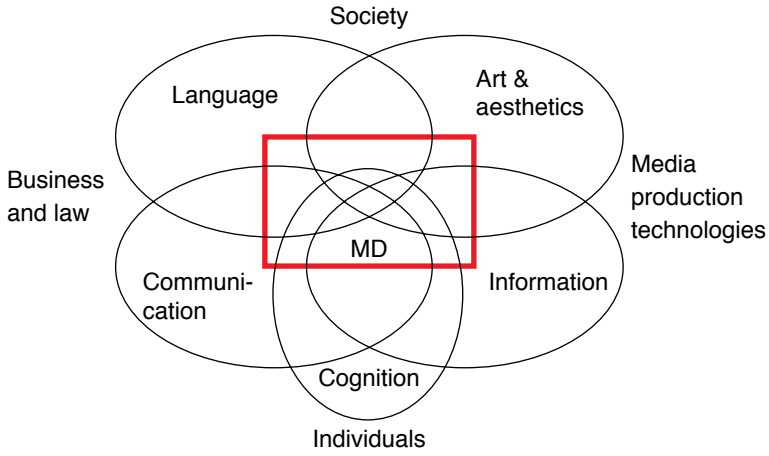

Figure 2. Message design is interdisciplinary and encompasses influences and facts from more than fifty established areas of research (Pettersson, 2002, p. 9). In this theoretical model, main areas in message design (represented by a rectangle, MD) are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.

Information design

Pettersson (1998, 2002) concluded that information design (Figure 3) can be hard to define, and it often goes by other names, such as *communication design* and *instructional message design*. I used the following definition:

> In order to satisfy the information needs of the intended receivers information design comprises analysis, planning, presentation and understanding of a message – its content, language and form. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements.

Information design has its origin and its roots in (1) *graphic design*, (2) education and teaching, or rather *instruction*, and (3) architecture and engineering, or rather *construction and production*. In these areas people have recognised the need for clear and distinct presentation and interpretation of verbo-visual information.

Any graphic message should be legible, readable, and well worth reading for the intended audience. Any audio message should be audible, distinct, and well worth listening to for the intended audience. The main goal in information

design should always be *clarity of communication*. The presentations might also be exciting, aesthetically pleasing and visually rewarding.

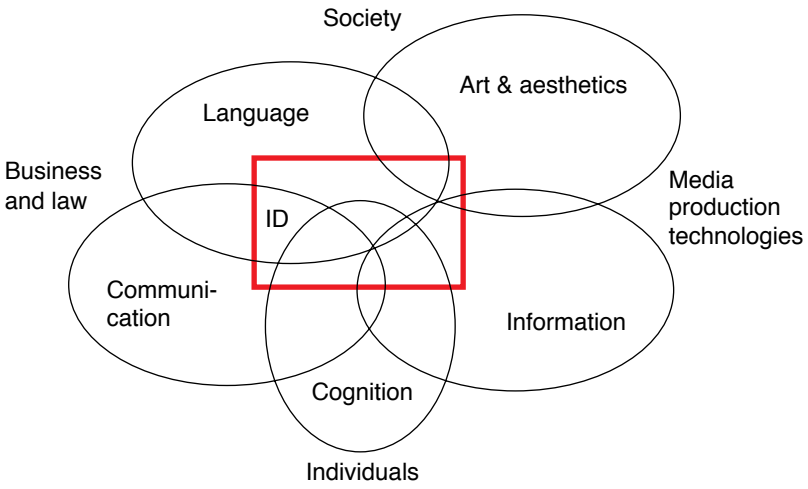

Figure 3. The information design model. Information design is interdisciplinary and encompasses influences and facts from more than fifty established areas of research (Pettersson, 2002, p. 19). In this theoretical model, main areas in information design (represented by a rectangle, ID) are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.

From a cognitive point of view, information design is less mentally demanding than *instruction design* and more mentally demanding than *persuasion design*. In instruction design the receiver (normally) is to *learn* from the message. They may, for example, have to learn the meaning of a new terminology. In persuasion design receivers are typically asked to *do something*, such as buying a specific product or a certain opinion. However, in *information design* the receiver only has to be able to *understand* the message in order to use the information in practical situations. An example is to understand how to walk out of a building. In many situations this may, of course, also result in learning. However, in these situations learning is usually not required.

Unfortunately, communication does not always function as anticipated. This may depend on insufficient information content in the message, but it may also be because one or more of the different steps in the communication process fail for some reason. Complicated language, in both texts and pictures, will impair the understanding of the message. Active voice, clarity, comprehensibility, consistency, legibility, precision, readability, reading value, simplicity, and structure are the key concepts in information design.

The creative process (Figure 4) is influenced by *message design principles*, and it is performed with *message design tools* suitable for the type of representation that has been selected. Message design principles can be seen as a set of guidelines for design and development of a verbo-visual message. Main creative processes for a verbo-visual message include the following four activities: analysis and synopsis, production of draft, production of script, and production of original and master (Pettersson, 2002, p. 32). Each activity includes a review process. When the production is finished the final product may be evaluated.

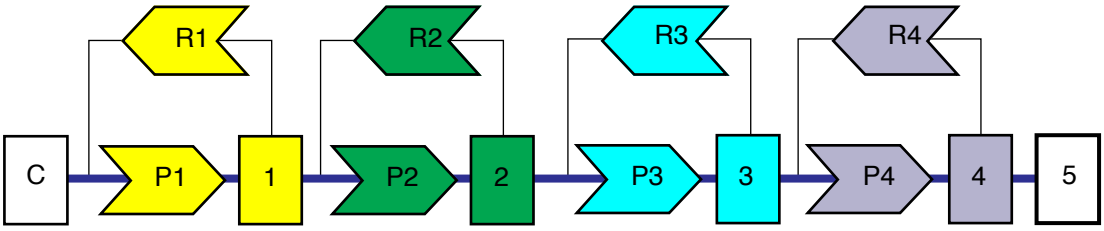

Figure 4. The creative process (Pettersson, 2002, p. 32) include four different levels of production (P) and review activities (R), or "sub-processes". The production activities are analysis (P1) and synopsis (1), production (P2) of draft (2), production (P3) of script (3), and production (P4) of original (4) and master (5). C = commission.

As a discipline and an academic subject matter information design has three main areas of knowledge: infography, infology, and infodidactics (Pettersson, 2002). Like the two faces of a coin, *infography* and *infology* are the two main parts of information design. The third area *infodidactics* is the methods used for teaching the various aspects of information design.

Infology

Infology is the science of verbo-visual presentation and interpretation of information. This is the theoretical part of information design. On the basis of man's prerequisites, infology encompasses studies of the way a verbo-visual representation should be designed in order to achieve optimum communication between sender and receiver (Pettersson, 1989, 1993). Infology models contain both theoretical (descriptive) elements as well as normative (prescriptive) elements.

Traditional communication models are directional and process-oriented. However, Hall (1980) developed the encoding – decoding model. Here the sender is an *encoder* constructing "meaningful" texts, such as a television program or an information material. The receiver is a *decoder*, and is assumed to accept, negotiate or oppose the intended meaning. Hall emphasized the paradigm shift to earlier traditions. During the 1990s there has been a change in recep-

tion analysis from a focus on interpretation and decoding to a greater concern with practice and use (Hagen, 1998). This development has been described as a change from decoding to viewing context (Morley, 1992). We can see the sender as an "information provider" (Figure 5). In each case the sender or the designer may have clear intentions and objectives. However, it is up to the individual "information interpreter" to actively conceive or misconceive the information, to use or not use it, to use or misuse it. This view is especially valid for information sets that people make available to an unknown audience, e.g. on the Internet.

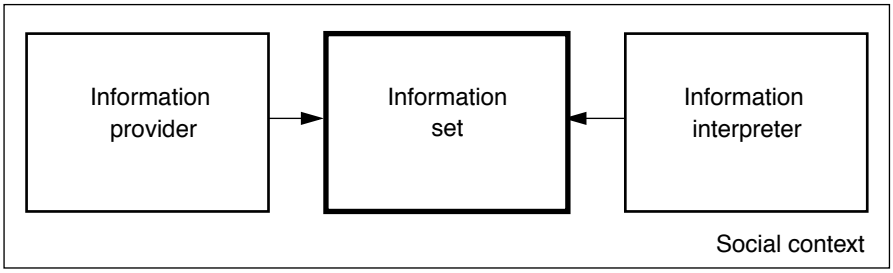

Figure 5. An information set model (Pettersson, 2002, p. 24). An information provider makes one or more information sets available for people who need the information, information interpreters. The focus is on the information set.

Infography

Infography is the actual, practical formation and execution of structured combinations of text, pictures, and graphic design (Pettersson; 1989, 1993). This is the practical part of information design. The term infography was initially used mainly for information graphics in newspapers and television, but has since been used in a wider perspective for formation and execution of all kinds of verbo-visual messages used for the presentation of information in all media.

An *information designer* needs to have skills in writing comprehensible, clear and consistent texts, in creating clear illustrations, and in creating a clear, transparent typography and layout that aids understanding and learning (Pettersson, 1997). He or she should also be a skilled project manager.

Art is valued for its originality and expressiveness. Its focus is on individual artefacts crafted through the manual and aesthetic virtuosity of the artist. Design, in contrast, is valued for its fitness to a particular user and to a particular task (Mullet and Sano, 1995, p. 8). Of course many designers may want to provide one or more aesthetic experiences where possible, but the design aesthetic is always related to the intended function of the information products intended for widespread distribution and use.

Areas of study

The study of information design can be summarised as a multi-disciplinary, multi-dimensional and worldwide consideration. We can view, analyze, describe and discuss information design from various perspectives. Prominent perspectives on information design are areas of design, types of content, parts of communication, types of representation, and message contexts.

Areas of design

In information design it is always important that the intended audience will be able to understand the messages. The reader must always be able to distinguish between figure and ground without any difficulty. Production of information materials is the opposite of camouflage, where the intention is to make a figure as much similar to the background as possible. In an oral presentation it may be better not to use any visuals at all than having to use low quality images. Poorly executed and poorly presented images will influence the understandings of the whole oral presentation. Simple pictures are "immediate." They speak to us holistically and emotionally. When readers get the "wrong impression" it may be very hard to change this later on.

Types of content

It is important to understand the intended content in information materials. What is the message? What is the influence of culture? A "types of content perspective" includes informative entertainment, brief messages, administrative documentation, factual information and instructions. We may also include advertising and propaganda as well as teaching aids in this group. All of these types of content may be used in different fields such as consumer information, economic information, geographical information, product information, public health and pharmaceutical information, social information, technical information and tourist information.

Types of representation

Words and pictures can be presented in different ways and with the aid of different media. Likewise a verbo-visual representation can be designed in different ways. Based on how the verbal information is presented to the receivers, we can distinguish three main types of verbo-visual representations (Pettersson, 1989, 1993). We read the printed words in lexi-visual representations, such as messages printed in a book or messages displayed on a computer screen. We listen to the spoken words in audio-visual representations, such as oral presentations with slides or overhead transparencies and in television pro-

grammes. We read printed words and listen to spoken words in a combination of lexi-visual and audio-visual representations in multi-visual representations, such as interactive multimedia systems.

The presentation of all the information available in a field is seldom possible. Normally, information-providers and other writers make a selection. This selection can be more or less subjective. The selection is seldom, or perhaps never, objective. This is difficult or even impossible. The different media have completely different abilities to convey information.

Message contexts

A context perspective on information design includes the inner context, the close context, and the social context. The inner context is an internal context. In a book, for instance, it is the relationship between various text elements, pictures and layout. We may also discuss the relationships between the image elements within a single picture.

The entire communication situation, i.e., senders and their intentions for the verbo-visual message, and receivers and their circumstances provide the social context. When we read a book or view projected images the lighting in the room may exemplify the close context. The close context and the social context are both external contexts. The context in which a specific message is presented has a major impact on the way that the message is perceived.

Work range

There are many information professions. Groups which mainly work with information, such as e.g. editors, information providers, journalists and marketers, all have similar knowledge of Man and knowledge of information and communications as starting points. They basically utilise the same methods and techniques in their jobs. However, their roles differ in society. Professional roles give each group a special identity and make different demands on loyalty, experience and know-how. The loyalty of an information-provider is to her/his employer. The loyalty of a journalist should be to her/his readers, listeners and viewers rather than to her/his employer.

Information designers can facilitate communication and the learning processes of the readers. Several activities are involved when an intended message is communicated from a sender to a receiver, and received as an internalized message. These processes are guided by principles, performed with the help of tools and influenced by the social context. Information designers work in a range of activities: form and document design; wayfinding systems; interactive and time-based infographics; digital content management; development of

knowledge structure and management systems; product and instructional design; technical writing and publications; and information architecture. Their work ranges from overall strategies for information formation and transfer, to specific solutions for data clarification and transfer. The main goal of information designers is to provide user-centered solutions, making the complex clear and relevant, and adding value to data and information.

In 2005 the partners of a federal US-EU Fund for the Improvement of Post-Secondary Education (FIPSE) grant for the Development of Core Competencies and Faculty and Student Exchange in Information Design listed the following essential competencies for an information designer. An information designer should be:

1. Able to identify the purpose and audience of a given project and explicitly design effective structures, information, and presentation appropriate to that project.
2. Able to cooperate with specialists to understand knowledge structures and the data/information in terms of content, topic and cultural context.
3. Able to organize content, including writing, editing, and schema technologies.
4. Able to understand and use various communication models to form information in a manner appropriate and effective for the data and the user.
5. Able to determine and coordinate the best delivery method/media requirements to make the information accessible and useable by the given audience, including visual, haptic, and auditory delivery methods, and computational schema.
6. Able to use appropriate presentation systems and environments, including software, hardware, and digital presentation technologies.
7. Able to assess the success of a prototype, using established usability and accessibility guidelines and testing methods.
8. Understand local, regional, national and global realities in problem assessment.
9. Understand and apply the business aspects of developing and delivering information.
10. Understand the ethical challenges that arise in everyday work environments and the necessary commitment to professional and ethical behaviour.

Around the world academic programs in information design vary according to emphasis placed by faculty on areas that contribute to the overall program, including graphic design, interface/interaction design, technical communication, communication models, linguistics, accessibility/usability, cognitive and

social sciences, statistics, computer science, network systems, and business. Programs are both intra-disciplinary within art and design, and interdisciplinary, based on specific goals and objectives of the program.

Adams (1999, p. 19) concluded that it is a difficult task to design good information-giving materials. When faced with poorly designed information products the users still largely blame themselves and not the information providers. However, the quality of the information sets can be greatly improved by appropriate usability testing. According to Adams a push for a research-based information design must come from the information designers. In each case, members of the specific user group may be invited to evaluate preliminary texts and sketches for drawings and photographs.

A pedagogical model

In this section I present the pedagogical model that we have used in several of our information design classes, in traditional teaching as well as in distance classes with e-learning. So far we have had very positive responses from the students. However, since people are different it should be noted that this pedagogical model *does not work for all students*. We have not been able to adjust the pedagogical model for students with different learning styles. *Furthermore many of our students have usually been highly motivated.* Maybe highly motivated students will learn regardless of the system used.

Anyhow, our pedagogical model is based on the theories of *combined learning*, with strong influences from areas like constructivism, learning from analysis and problem solving, and cooperative learning. As previously noted we may assume that, in many situations, several learning processes are involved while we are learning. Our goal is to work with methods creating commitment, motivation and learning. The teacher becomes a supervisor and a co-worker rather than a traditional lecturer. The students own study of carefully selected literature is a base for discussions and understanding of the subject matter.

Active processes

Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in (Funderstanding a, 2005). Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accomodate new experiences.

Constructivism is grounded on the philosophy of Dewey, Kant, and Vico, and the psychology of Piaget, Bruner, and Bartlett. In constructivism knowledge

is a function of how individuals interact, create and construct meaning from their own experiences and their own physical and social context and environment. Cooper (1993) traced the paradigm shifts in instructional design from behaviourism to cognitivism and then to constructivism.

Constructivists emphasize situating cognitive experiences in authentic activities (Thompson, Simonson, and Hargrave, 1996). Reality is neither unitary nor fixed, but constructed. The mind is central to the constructivist view. Rather than mapping concepts on the mind of the learner (as with objectivism) constructivism attempts to help individual learners construct their own knowledge from their own experiences and their own understandings of reality.

The *learner* is the central focus in the constructivism model, not the instructor or the teacher. All individuals have a unique set of experiences, and different perceptions of their own realities. Knowledge is constructed and developed by the individual learner through interaction with her or his environment (Jonassen, 1991; Wheatley, 1991, Steffe and Gale, 1995). In our case learners work together in a cooperative learning environment. Thus they support one another when they learn. In our case learners work together in a cooperative learning environment. Thus they support one another when they learn. Each individual mind builds different symbols. Since each mind develops different symbol structures, each mind perceives reality as well as all kinds of information materials differently; although common understandings may occur.

In my view learning is an active process. Constructivist environments facilitate learning through collaboration, interaction with information material, context, and construction of knowledge. A major assumption in constructivism is that even though reality exists outside language, we can only know and communicate about reality through formal speech and discussion. Media may support constructivist learning environments, but they do not control it. Through assimilation and accommodation, individuals use many elements of the learning context and relate those elements to their own experiences; thus, creating new knowledge. At school the classroom holds no special status and it is usually important to improve the learning environment in the classrooms.

Kumar et al. (1994) noted that in hypermedia it would be possible to track the performance of individual learners. The flexibility of hypermedia documents with their systems of nodes and links allows the learner to pursue her or his experiences in a self-directed, non-linear way. This is consistent with the constructivist model of learning. Hypertext capabilities, different navigational structures, and content exercises are examples of information design features that enable each individual student to construct knowledge in a constructivist manner.

In traditional distance learning, like the Open University in the UK, much work is put into developing teaching materials. This requires heavy investment and is based on the assumption that a large number of people shall learn the

same subject matter at the same time under the control of the teacher, directly or in the way the learning material is designed. It takes between two and three years to develop such a course. The dialogue between the teacher and the student occurs primarily to secure that subject matter content is understood the way it was intended. With complete self instructed material no questions needs to be asked. The development of multimedia teaching programmes corresponds with this model. The material is not flexible, and the teaching is carried out based on the needs of the teacher, not the needs of the students.

Slavin (1995) found that social interactions and problem-solving skills were enhanced when cooperative learning was combined with technology. It also improved the overall classroom climate.

Students work together

Cooperative learning consists of instructional techniques that require positive interdependence between learners in order for learning to occur (Funderstanding b, 2005). In cooperative learning the dialogue is primarily between students, not with the teacher or with traditional teaching materials. However, a continuous dialogue with the teacher is desirable to secure understanding of the subject matter content. According to Kristiansen et al. (1994), the ideal learning situation includes (p. 23):

> ... the best possible contact with the fact about which one is to learn using the senses, the possibility of contact with people of the same ability who can create a good learning environment and with whom one can discuss, the best possible professional and pedagogical preparation with a view to learning and the opportunity for dialogue with helpers. And the most important; a learner who is knowledgeable about the learning process and his own role in it, who is motivated for the learning work and who believes in himself.

Cooperative learning is effective for developing problem solving skills in various content areas and grade levels (Johnson and Johnson, 1999; Chen and Caropreso, 2004). From a teaching philosophy perspective, cooperative learning is consistent with constructivism primarily due to the role of social interaction. According to some researchers learners who work together in a group co-construct more powerful understandings than individual learners can construct alone (Eggen and Kauchak, 2001). It should, however, be noted that there are different styles of learning, and cooperative learning does not work well for all students.

In our pedagogical model the emphasis is on the learner, not on the teacher or the technology. Students have access to a *Study guide* with important information (Figure 6, 6a and 6b). They use a *Virtual classroom* when they work

together with group assignments. Students also have individual assignments. We have documented the development of this model (Pettersson and Andersson van Limbeek, 2002).

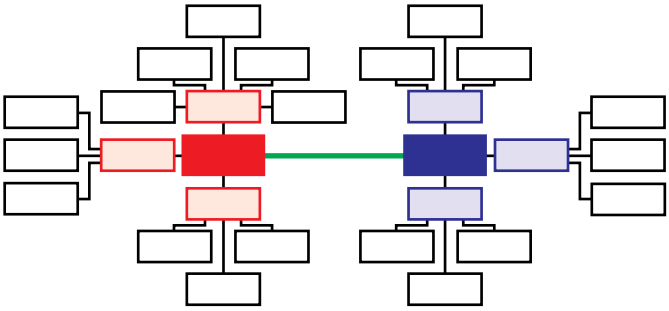

Figure 6a. Our "pedagogical model." Please see the following enlargemants 6a, and 6b for all the details.

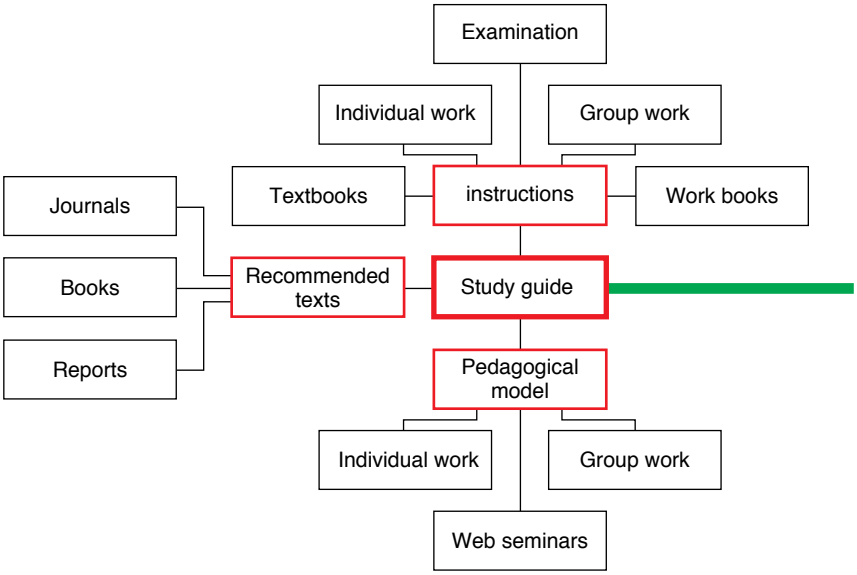

Figure 6b. According to our "pedagogical model" students must have access to a comprehensive Study guide with information about the course. Students have easy access to instructions and to some of the recommended texts.

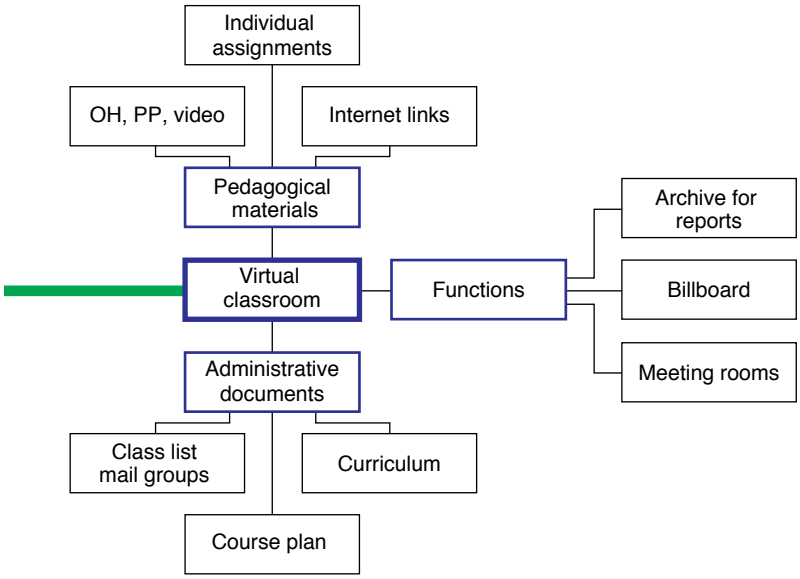

Figure 6c. During the course all students may use a Virtual classroom when they work together with group assignments. Here they can upload their own individual assignments. In this way all assignments are available for all students in the class.

Assignments

When working on *group assignments* students need to have continuous contact with each other. This can happen with personal meetings or by means of electronic mail, fax and electronic meetings in the different "virtual group rooms" or on an "electronic billboard" in a virtual classroom. In the present system there is a group room for each group. The members of each group will decide how they want to work together.

These group assignments are concentrated on analyses, discussions and reflections of questions within each of the five modules of the course (Figure 7). It can be advantageous for students living close to belong to the same group. This makes it much more possible for them to arrange personal meetings if that becomes apparent.

Each group of students makes a joint presentation of the compulsory assignments within each course module. When necessary the groups may get guidance during the work with the different assignments. Groups may spend a minimum of two and a maximum of four pages on each *module report*. In order to make it easy to compare the reports, these should all have a clear and uniform structure. The names of all the group members who have taken part in the work are noted on the front page. The module reports are examined and corrected

within each group *before* they are uploaded in the virtual classroom. Then the module reports are automatically available for the rest of the students.

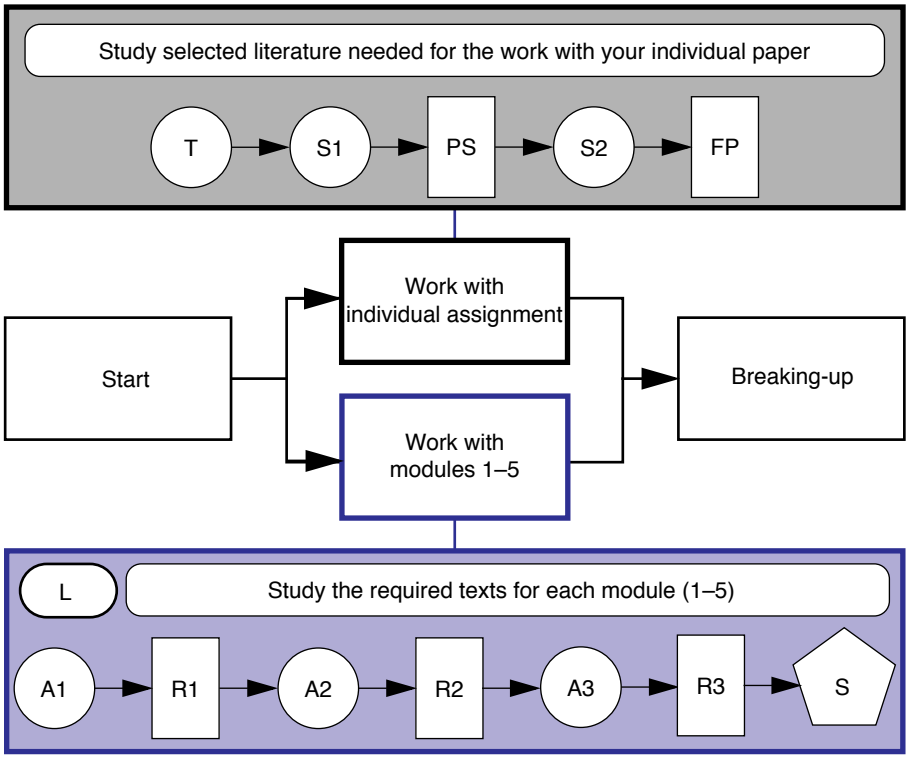

Figure 7. A model for the work in an information design course.
The work with the individual assignment includes a selection of a topic, review and selection of literature (T); continuous studies of selected literature and work (S1) with a provisional script (PS); work (S2) with review and editing of this script until a final paper is finished (FP). This paper is uploaded in the virtual classroom.
Each course module may include a lecture (L) or some prepared learning material. All five course modules include the study of the required texts for each module, the work with group assignments (A1); uploading of the finished module report in the virtual classroom (R1), downloading, reading, discussing and commenting on a module report from another group (A2), uploading these brief comments in the virtual classroom (R2); reading, analysing and discussing the comments on the own report (A3), and bringing the final report (R3) to the concluding seminar for the course module (S).

Each group will have to download, read, analyze and discuss a module report from another group (according to a special plan based on the number of groups). Each group will then write a *brief comment* (one page) and upload this into the virtual classroom. In these brief reports the group should point

out what is good and what is bad with the module reports without paying too much attention to formal and linguistic aspects. That is up to the writers themselves. Each group will download and read the comments on their own report before the seminar. In the seminars the groups will have direct contact to discuss problems related to the contents in the module.

According to this pedagogical model each student must take an active part in work with all group reports, all discussions and all reviews of reports from other groups, and also write an *individual essay* (Figure 7). This is important for grading.

Conclusions

It may be easier to get an overview of the various conclusions if we bring all the section conclusions together in one list. I believe that it is possible to create valuable courses and programs in information design if we consider these conclusions:

1. Information design students have different backgrounds and they use different learning strategies. We should plan teaching in such a way that a large part of the students actually learn what they are expected to learn.
2. Information design has a practical as well as a theoretical component. Main areas are language disciplines, art and aesthetics disciplines, information disciplines, communication disciplines, behaviour and cognition disciplines, business and law, and media production technologies.
3. An information designer needs to develop skills in writing comprehensible, clear and consistent texts, in creating clear illustrations, and in creating a clear, transparent typography and layout that aids understanding and learning. The main goal in information design should always be *clarity of communication*.
4. When students like to work together they may take part in and benefit from a *cooperative learning process*. In this case the teacher becomes a supervisor and a co-worker rather than a traditional lecturer.
5. The context in which a specific message is presented has a major impact on the way that the message is perceived. We need to take into consideration that even when we follow all information design principles the individual "information interpreter" may conceive or misconceive the information, may use or not use it, may use or misuse it.
6. Regardless of the selected medium, a well designed information material will satisfy aesthetic, economic, ergonomic, as well as subject matter requirements. A well designed information material makes everyday life easier for people, and it grants good credibility to the senders or sources.

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