Visual Scientific Communication
The Use of Graphics in Contemporary Doctoral Theses

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Abstract

Although we live in a society abundant with images, the subject of illustrations in scientific communication seems to have become a blind spot. The study of scientific communication is an interdisciplinary field, where written and visual language is studied separately from one another. The aim of this master thesis is to break with tradition and look at the use of illustrations, their form and frequency, in a random selection of Swedish contemporary doctoral theses to make an attempt to explain why some scholars do not use illustrations as much as others. The found graphics are discussed in their faculty and departmental context, and the aspects of page design, electronic availability, and publishing tradition are also included in this discussion. By looking at some activities surrounding the author of a doctoral thesis, such as writers’s manuals, computer graphic tools, and the role of librarians, proof was found to support a genre and activity theory, as described by Charles Bazerman. This study presents an overview of illustrations occurring in dissertations in a way that was not done before, opening up for further studies about the form and function of scientific illustrations as important carriers of information.

Sammanfattning


Ämnesord

Visuell kommunikation, vetenskapliga illustrationer, bilder, datorgrafik, naturvetenskap, samhällsvetenskap, vetenskaplig publicering, universitet.

Key words

Scientific visualization, visual communication, illustrations 2000-2010, computer graphics, natural science, social science, doctoral thesis, Bazerman.

Övrig hänvisning

Bildmaterialet i denna uppsats har använts i enlighet med /Lag (1960:729) om upphovsrätt till litterära och konstnärliga verk, //§ 23,/** om citaträtt i vetenskapliga framställningar.
Für Christoph
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Introduction

During my university studies I could not help but noticing that the scientific material I was presented with – in the form of books, articles, research reports and dissertations – were poorly illustrated, i.e. illustrations were scarce.

The combination of written language and graphics is indisputably an efficient way to convey information, and this is how I – a “product” of the latter 20th century Swedish society – expect communication to take place. When it does not, I ask myself why. Is there a strong tradition that prohibits the effective use of visualization of knowledge in scientific communication, or does the author simply not know how to produce meaningful illustrations to go with the text? There is a lot of talk about information literacy, but what about visual literacy?

When I started to look for more information about information literacy in general, and visual literacy in particular, I was surprised to find that the subject seemed to have been totally overlooked in my own discipline, Library and Information Science. I found that the study of scientific communication is an interdisciplinary field, where written and visual language is studied separately from one another. While texts have been studied by a number of social science and humanities disciplines, such as linguistics, philosophy, psychology, history, and education, the study of illustrations has been left almost entirely to art historians. Needless to say, they have not shown much interest for scientific visuals, the main purpose of which is to be instructive and carriers of information, rather than aesthetically pleasing. Therefore, these visualizations of knowledge seem to have become a blind spot.

However, there are a few research teams that have focused specifically on scientific illustrations, and what is important, always in combination with the written language, so that they are analysed in their context. As you will notice in the next chapter, these have bearing on my summary of historical and contemporary research as well as choice of theory.

For my study, I have therefore decided to go hunting for illustrations in a number of recently published doctoral theses. Included are all faculties from the humanities and social sciences to medicine and technology. I need to know if there are illustrations at all, and what they look like and compare the result from the various disciplines.
I could have chosen to look at articles or regular monographs, but dissertations are a good choice, as they are easily connected to a specific discipline, and can be seen to represent the gist of a certain university or field, and the education these provide to the authors.

**Aim and Questions**

For my study, I wanted to investigate the application of illustrations in scientific communication. The idea was to see if my observation about poorly illustrated scientific reports within social science and the humanities would be confirmed. I searched in vain for similar studies and therefore I realised that I would have to start with simply looking for images in a small specific wedge of academic publishing, and concentrate on a few simple questions, and also include all fields of science, to be able to make any generalisations about the results.

Hence, I chose to look at doctoral theses (also called dissertations) for the following reasons:

- They are published with the help of governmental funding, and are therefore not expected to add to profit as is the case with journal articles and business reports,
- The authors are recently educated within their departments and can be seen to represent their gist at one point of history,
- The expected reader is to be found in a smaller crowd, with similar education and professional interests as the author.

My questions are:

1. Are illustrations applied at all, and in that case, what do they look like? In what frequency, form and colour do they appear?
2. Is there a pattern that relates the use of illustrations to the traditions of each discipline (epistemological and/or linguistic aspect) or department (institutional aspect)?
3. Is there a pattern that relates the use of illustrations to modern computer technology?
Previous Research

History

The English Renaissance

The rise of humanism originated in the 13th century with Thomas Aquinas’s realism and description of the day-to-day world, and this is where Elizabeth Tebeaux’s story about technical writing in the English Renaissance takes off. Tebeaux is professor at the English Department of Texas A&M University, and she devotes her research to a kind of literature that has been overlooked: the technical manuals, the how-to and self-help books on health, farming, gardening, animal husbandry, estate management, navigation, and such. These were directed to both general and expert readers, sometimes addressed as separate groups, sometimes together, seeing as a broader public meant more profit. Studies of the number of published and sold books have shown that only religious books were more popular.

Hence, to the usual traditional renaissance genres of comedy, satire, epigram, and epistle, the technical manual must be added for a better understanding of the era, says Tebeaux. Aquinas’s interpretation of the bible was that not the intellect, only the human will, was affected by the (biblical) fall, and this position led to a new belief in human reason and in the arts, and had the effect on art, that it became less symbolic and more realistic. Before, people were pictured depthless, one-dimensional and now the emphasis turned on nature as organic, living and changing, and infused art with human and natural subjects. Writing began to show the same richness in dimension and detail, and the textualising of information came to suggest that text was synonymous with truth. From this followed that literacy came to mean the power to know truth by the printed page. Literacy and text gave people the ability to begin to free themselves from superstition and the allusions to God declined.1

Differences between page design in technical books and in philosophical, literary and religious books suggest that technical writers also knew that technical books would be read rapidly and for information and reference, while other books would be read slowly and leisurely.2

Tebeaux argues that it was humanism that gave rise to technical discourse, with its assumption that humans, if they read the right manual, could successfully

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accomplish any practical act, whether that be medical care, keeping accounts or raising sheep. Technical writing emerged for several reasons: the increasing literacy, new technical inventions that made possible the spread of printed text, the increased welfare through England’s political power at that time which created a demand for books in the vernacular, not least the instructional books that allowed less fluent, but impatient, readers a means of self-education. The books were often printed in pocket size, and were meant to be brought to work and used on a regular basis. In addition, the growth of the population and new fields of knowledge had as consequence that you could no longer depend on oral transfer of this knowledge alone.

The display of information in tables and new page design increased steeply after 1570, probably as an effect of Petrus Ramus, (or Pierre de la Ramée, a French educational reformer) whose revolutionary ideas about adding white space and numbered lists to facilitate access to the information in printed texts inspired other writers. Also, by the start of the 17th century, roman type increasingly replaced script type to improve the legibility of print, and woodcut and copperplate drawings were used for illustrations. Unlike the illumination techniques used in religious works, these were functional and communicative rather than ornamental. By contrast, the philosophical and liturgical texts kept their ornamental typography, because they were expected to be read slowly and thoughtfully.

To summarize Tebeaux’s account, technical writing by the year of 1640 differed from the philosophical not only in topic (health versus political rhetoric) and genre (pocket size versus leader bound heavyweights) – but also in appearance, i.e. white space and tables versus extremely dense black text.

The Scientific Journal

Another new literary genre that appeared in the 17th century was the scientific article, the history of which is analysed by Harmon and Gross in their fresh-from-the-press anthology. They maintain that the scientific article is one of the most robust literary genres around today, and its literature carries enormous prestige within our society and benefits from a long and distinguished history. What happened was that – as the pace of scientific activity accelerated – the scholars got impatient with the method of printing books, a once revolutionary invention that now felt slow, because you waited a year or two to get a manuscript published. Instead these “generalists” (the term scientist was coined around 1800) started to communicate recent findings through personal letters, “the learned letter”, which

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3 Tebeaux, 1996, p. 177.
4 Tebeaux, 1996, p. 36f.
was much quicker and travelled over country borders. This was the beginning of the scientific article.

The oldest journal in England, *Philosophical Transactions*, was founded by The Royal Society in 1665 – and is still publishing. The society functioned as a club, research institute and publishing house in one, and every gentleman was welcome to join, as long as he paid his due. They were both authors and audience and knew each other. It is interesting to note that the early scientific article asked the audience to trust the author more than the details of the science. The authors drew upon qualitative experience, and used a more personal voice. Furthermore, in the early article, there is no trace of organization of article elements.6 To exemplify, Harmon and Gross bring forward a 17th century passage about botany, which showed:

> Good storytelling, strong verbs in an active voice, first person narrative, figurative language, rhetorical flourishes, circumstantial details, no esoteric words other than Latin names.7

In the centuries to follow, graphs become more and more central as the sciences move away from the descriptive and qualitative, and toward the mathematical and quantitative. The author typically plotted one variable, such as time, and another dependent variable, such as a property that changes over time, and the graph with its two axes neatly communicates multiple data points at one glance. The graphs were used to show cause and effect or to offer a larger mass of data for comparison.

As the sciences develop, they diverge rather than converge. In no sense do the various sciences appear to be advancing toward the impossible dream of a single theory that would explain the whole of nature. Rather, each science is developing explanatory structures appropriate to its enterprise. To exemplify, Harmon and Gross bring some of the most famous illustrations of science that is known to everyone, such as (i) Mendeleev’s periodic table of chemical elements first published 1869 in Russian, (ii) Einstein’s equation of relativity theory from the field of physics, and (iii) the DNA double helix, sculptured in the 1950’s by Crick and Watson, from the field of biology (Illustration 1-3).8

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6 Harmon and Gross, 2007, p. 3ff.
7 Harmon and Gross, 2007, p. 221.
Illustration 1. Mendeleev’s Periodic Table of Elements as we know it today. There was only one significant change in 1913: the chemical elements are since then classified according to atomic number instead of atomic weight. This is a free (public domain) periodic table of the chemical elements that you can download, print, or use however you like.9

\[ E=mc^2 \]

Illustration 2. Einstein’s famous equation “Energy equals mass times the speed of light squared” has been etched in the memory of all pupils and can therefore be regarded not only as an equation but as an illustration in its own right.

Illustration 3. The double helix structure of deoxyribonucleic acid (DNA) was first constructed by Watson and Crick in 1953. Since then the model has been illustrated in endless ways in the form of computer graphics. This graphic is freely available and may be used without special permission.10

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The scientific article acquired its present modular and canonical form during the 1830s and 1840s in German chemical literature. They had three different structures, those of a theoretical, observational, and review article. Another turning point in the long history of scientific articles was when Albert Einstein published his four groundbreaking articles in the journal *Annalen der Physik* in 1905. This marked the beginning of a century when nearly all major scientific advances appeared first in scientific articles, not books.

**Darwin’s Photographs**

Moving to the 19th century, Philip Prodger provides a concrete example of the illustration as a strategy tool. He has studied Charles Darwin’s “The Expression of the Emotions” published in 1872. For this specific subject the invention of photography became crucial to Darwin. Although he did not take his photographs himself, Darwin understood the technique well enough, having seen it being developed by his university friend William Talbot, who invented the photographic process that would outrange the French daguerreotype.

What Darwin did, was to have photographs taken of people at a close-up, and told them to look afraid or astounded and such to prove his point about muscle and nerve actions lying behind the facial expression as well as behaviour due to biological need (such as baring the teeth to attack). Darwin argued that these photographs were more objective than the drawings and paintings that had been used in similar works – because photographs showed people “in action”. However, Prodger points out that the ability to capture rapid movements was limited at the time because of the long exposures. It is more likely that Darwin used photographs to communicate meaning that was not actually in the photographs he presented, and far from being scientifically factual, these photographs formed part of a narrative strategy designed to advance Darwin’s theories. Still, photographic imagery was soon understood to be a standard of truth in popular as well as scientific and documentary applications.

At the end, Darwin’s book on expressions included 29 photographs and, more intriguingly, some engravings made from photographs. It seems that Darwin used engravings at the beginning and end, and photographs only in the middle in order to not scare away the part of the audience that felt more comfortable with traditional scientific communication.

Prodger concludes:

Notwithstanding the tremendous flexibility photographers now have in altering their images electronically, photography is still used authoritatively in contemporary theoretical discourse.

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11 Harmon and Gross, 2007, p. 188ff.
The capacity of photographs to objectively communicate information is unrivalled in the history of visual representation.¹⁴

*Computer Graphics and Corporate Business*
Moving to the 20th century, Robert Griffin presents some research on how growing computer industries innovate the area of business as well as academic communication in the 1960s and 1970s.¹⁵ IBM first introduced the flip chart, Eastman Kodak came up with the 2x2 slide projection, and 3M developed the overhead projection media. These were all used in face-to-face presentations. The 1980s brought the personal computer and new possibilities for everyone to create their own graphics. Until the advent of desktop publishing and word processing software, it was difficult to include visuals in documents. Usually they had to be inserted by an old-fashioned cut-and-paste method, where the visual was glued into a spot which had been left in the text or placed in an appendix at the end of the document. Now you can insert them electronically. However, this is no guarantee for better quality, as long as the users know how to work the new tools.

Equations, tables, and pictures were frequent in the typical scientific article up to the 19th century, but then they get scarce again because of the expense involved in drawing and publishing them. The question today is if it is worthwhile to commission an artist to create effective visuals, or if it is realistic that authors make their own computer graphics. The process of producing visuals by an artist would take several days and cost about 100 dollars per visual, according to Griffin’s estimations.

The technological advances made it possible to provide mountains of data never seen before, and as a consequence, some substantive changes have taken place in visual communication, as scientists try to cope with this flood in order to better understand and communicate their results. The front of data-driven research is found in microbiology. They have enjoyed great success because of the invention of machine-driven, automated techniques for sample analysis and acquisition. Massive data in tables or graphs overwhelms the eye, so to improve communication numbers are transformed into colours to uncover complex relationships.¹⁶

History of science, history of arts, scientific communication, and visual studies are the academic research fields that join hands in this study. The subject of visualisation in the doctoral thesis is but a small wedge in the field of science communication because of the limited circle of readers, and although I particularly want to concentrate on their own visual language, the above general history account of visualisation is also relevant. Except for sheer pictures, visual design

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includes other features of page design such as font type, headings, white spaces, indents, and bullet lists, which I will reflect on as well.

**Contemporary Research**

The scientific study of science – and its representation in form of scientific publication – is an interdisciplinary field, dealt with traditionally by historians, philosophers, and social linguists, among others. In the case of my own discipline, library and information science, the study of scientific publications was a slowly dying field, but is once more growing, owing to the technological advances and the World Wide Web. Their research concentrates on bibliometric methods, such as citation analysis, term frequency measuring, and the grammar of a text, among many others. However, what this research does not consider is the form or frequency of illustrations. It is evident that pictures are constantly disregarded, overlooked, and ignored when texts are analyzed in one way or other.

Where does one look for research on images then? The answer is in the long tradition of the history of arts. However, since art generally is perceived as something of a “finer culture”, many types of visual representations, such as comics, posters, and chewing-gum packets, not to mention pie charts, have simply been overlooked in this discipline, too, at least until very recently.

*The New Field of Visual Studies*

In the aftermath of the cultural turn, a new field called visual studies developed in the United States in the late 1980’s. It grew out of art history, anthropology, film studies, linguistics and comparative literature. Visual studies, also known as visual culture, are part of the humanities, and explore the history, theories, methodology, and the pedagogy of the cultural construction of the visual in arts, media and everyday life. Margaret Dikovitskaya is professor of art history at the University of Victoria in British Columbia, and describes in detail the visual studies presently taught in four United States universities. Her research is relevant for this study, in that it summarizes the trend of education trend offered to future scientists. Visual studies (much as cultural studies) developed as a reaction against the analysis of high cultural forms. At the beginning, questions were raised about high and low culture, visual art versus visual culture, signalling the wish to give up the dominating and hierarchizing cultural memory.

Visual studies do not have a structured methodology of its own, and the lack of a common theory causes some problems for those who teach visual communication. The theoretical approaches are among others poststructuralism, feminism, Marxism, queer studies and psychoanalysis, but no consensus seems to

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be developing in the theory building of this field. W. J. Thomas Mitchell, professor of English and art history in Chicago, explains the lack of a systematic methodology in visual studies by comparison to the field of linguistics. “There is no Chomsky, Saussure for visual culture”, he says. Language is based on a system of syntax, grammar, and phonology that can be scientifically described, whereas pictures and visual experience may not have a grammar in this sense. “There is some kind of excess, density, and plenitude in visual culture that escapes formalization”.18

Dikovitskaya’s book includes 17 interviews she made with professors from four US universities, where they describe the courses given and in what way they want to inform their students. Summarizing the results, she could detect three different schools: one that sees visual studies as an appropriate expansion of art history, one that considers the field to threaten the traditional discipline of art history, and one that sees the new focus on digital issues relevant to the virtual reality.19

One of the interviewees, W. J. T. Mitchell, coined “pictorial turn” in the 1990’s, alluding to the cultural turn, which meant that scientists did not see culture merely as a reflection of society anymore, but as an active player in constructing society. Scientists stopped creating social categories like “women” or “teenagers” and expecting them to represent a homogenised group, but went from quantitative to qualitative methods, in that they started to look at the individual motivation, and the way the same people behave differently depending on context.20

One of the main questions that visual culture addresses is “What is it that you learn when you learn to see?” and every expert finds a different answer. To Mitchell the objects of visual culture are also buildings and landscapes. Although not representatives, they are objects that are looked at in everyday life.21 Thus, the students are taught to reflect on the impact of images at the receiving end, how to read and understand an image, but also how to figure out the motivation behind it and grasp its manipulative potential. The students are treated as consumers, and seen as producers of visual culture only in a philosophical manner, along the lines of the cultural or pictorial turn (creating by using). In the practical manner, the student is not seen as a producer of pictures, and there is no mentioning of a course, where students are actually taught to construct pictures for themselves.

To summarize this far, the study of the image has in recent times moved from art history into a field of its own, referred to as visual studies. However, since this field has not yet contributed to new theory constructions or models accepted by a majority of colleagues, it is questionable if it can be called a field of its own. An

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18 Dikovitskaya, 2005, p. 239.
20 Dikovitskaya, 2005, p. 80.
21 Dikovitskaya, 2005, p. 54.
important player in connecting all contemporary research done on images is a professional organization called the International Visual Literacy Association (IVLA).

**International Visual Literacy Association**

IVLA was founded after a meeting in Rochester in 1968, co-chaired by among others Jack Debes from Kodak and Colin Turbayne of the University of Rochester. IVLA has its 40th annual conference coming up in October 2008 in Virginia, USA. The conferences also took place in Canada, South Africa, Brazil, and Sweden (2001 in Eskilstuna). IVLA publish the *Journal of Visual Literacy* (JVL) twice a year, and there are also a number of books that have been published in connection with the IVLA annual conferences, one such book being *Visual literacy – a spectrum of visual learning*, edited by Moore and Dwyer. It is meant to function as teaching material on the college level, and includes no less than twenty-two chapters, all dealing with a different perspective on the theories borrowed from linguistics, art, psychology and philosophy. The focus in the essays is on the cultural, social, political and technological aspects of visual culture as well as human perception, the cognitive mind, the human anatomy, body language, definitions of visual versus verbal language, the use of visuals in business, industry, and schools, and finally, but not least, visual design.

**The Cork Exhibition**

A rare example of research of visual carriers of information within a university campus is presented by James Elkins, a historian that organised an exhibition in Cork, Ireland, 2005, where over 60 departments of a “typical contemporary university”, i.e. University College Cork, were invited to show the illustrations currently used in their faculty. Elkins’s endeavour, similar to the professors interviewed by Dikovitskaya, was to start to think about images beyond the confined fine art, including painting, sculpture, architecture, television, and advertising. He wanted to “listen” to the visual buzz of the university world without prejudice.

A great deal is at stake on this apparently unpromising ground. It is widely acknowledged that ours is an increasingly visual society, and yet the fields that want to provide the theory of that visuality – visual studies, art history, philosophy, sociology – continue to take their examples from the tiny minority of images that figure as art.

The exhibition resulted in a book of 30 collected papers from the fields that were represented. Already the response of the departments, i.e. which contributed and which did not, was contrary to Elkins’s expectations. Because Elkins’s results are

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the closest reference I have found to my own investigation, I will come back to them in my discussion.

Centre for Image Analysis in Uppsala
In collaboration between the Swedish University of Agricultural Sciences and the Uppsala University, a Centre for Image Analysis was created in 1988. The centre hosts a number of projects, where new methods for digital image production, as well as the analysis of digital images, are developed, the important characteristic being that these pictures can be stored in a computer as numbers. The research includes, e.g., analysis of 3D, microscopic, or geometric images, in grey or colour tones. An example of a practical application is forest inventory, where it is possible with the help of high resolution air photos to identify tree tops, and in so doing, tree species. The aim of the centre is to increase knowledge and use of auxiliary means such as cameras, scanners, printers, computer software, and storage systems. Within the last 10 years, 40 theses originated from the projects of this centre. None of these are included in my sources, as none was published in 2007.

In answer to my question how knowledge about images can be spread in the humanities and social sciences, the head of CBA, Ewert Bengtsson, gave the information that it is much less frequent, but as an example the centre use their knowledge to help analyse the used surface of stone axes to try and figure out what they were used for, or make comparisons between a photo and a painting to see if the painting was made from the photo.

Terminology

Graphics versus Written Words

Graphics, Images, Illustrations
The words graphic, image and illustration are used as synonyms. However, the word picture is avoided, since it might be mistaken to mean only photographs or only drawings.

What is Text?
When we think about texts, where does the line go between graphics and written words? What is text? What is illustration? The definitions of text overlap those of

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24 Web site of Centre for Image Analysis (March 29, 2008).
work and document, a matter of great interest among library and information scientists. This means that text often covers both images and written words together. It follows a short summary of a couple of these definitions.

Smiraglia states that a work is a set of ideas created by an author, composer, or other. Borrowing from Patrick Wilson he continues that as a bibliographic entity, the work has two properties: a physical (the package) and an intellectual, and together they constitute a title (a work) in the language of librarianship. Smiraglia also mentions Hjørland, who discusses the concept of document against the concept of text. Hjørland makes the distinction between the carriers of text and the texts themselves, and also admits to a blurred distinction between texts, works and information. In their discussions they all seem to include the matter of illustrations in a vague manner, at the same time as they are left out.

Suzanne Briet saw this differently in her pioneering work Qu’est que la documentation? back in 1951, where she defined document as any material form of evidence. Document carries the meaning of instruction and proof from Latin, but Briet’s definition is much wider and more abstract:

Is a star a document? Is a pebble rolled by a torrent a document? Is a living animal a document? No. But the photographs and the catalogues of stars, the stones in a museum of mineralogy, and the animals that are catalogued and shown in a zoo, are documents.

Michael Buckland points out that Briet and her generation started to emphasize the function of a document rather than the traditional physical forms of documents, a view that is more important than ever in the up-and-coming digital era. Also the word documentation has replaced the term bibliography to denote the techniques needed to manage documents in libraries.

The view in this study is that the terms documents, works, and texts can be used alike to denote both the thought and the form in which it is presented, and that illustrations are included in this package as carriers of in the same way as the written language. Therefore text is not a synonym to written language, but an encompassing word for both written and visual language.

What is an Image?
Images are the product of painting, as texts are of poetry, W. J. T. Mitchell says, and these two have always been arguing, whereas the third art, that of music, kept some distance. This is because poetry and painting claim the same territory of reference, representation, denotation and meaning, and music does not. Although there are ambitions for a unified theory of arts, there seems to be no end to the “war of signs” between words and images, and actually you cannot really compare

them, which makes it so much more irresistible to assert some sameness or transference. If images are about space, stasis, and arrested action, words are about time, motion and action, Mitchell goes on. “The debate of poetry and painting is never just a contest between two kinds of signs, but a struggle between body and soul, world and mind, nature and culture”.

Mitchell sees ideas as images, i.e. the very idea of an “idea” is bound up with the notion of imagery. He recollects that there were times when images had more power over us than today, when people were fighting their own over the question of purifying churches of idolatry, or more abstract, fighting for the “idol” of monarchy such as in the English Civil War.

Mitchell proposes to look at the various images as a family, and orders the images in a tree as family members. He goes on to explain that on one end he puts mental and verbal images that would seem to be images only in some doubtful, metaphoric sense. These are very different from graphics, which must be seen as real material pictures. However, Mitchell is teasing the reader, and did not actually weigh the importance of reality in this chart, as he on the contrary wants to prove that images “proper” (Mitchell’s quotation marks) are not stable or permanent, and they are not perceived in the same way by viewers any more than are dream images.29

To summarize, I will in this study be dealing with these “material” images, however remembering that there was an original mental image – as in idea – that the author wanted to communicate to the audience. It is crucial to knowledge communication and in order to teach something that this mental image is understood by the reader as it was meant. The combination of visual thinking, visual communication, and visual learning is what adds up to visual literacy.

Illustration 4. W.J.T. Mitchell’s image family tree. (Illustration reproduced by Elisabet Steiner)

Who is Visually Literate?

The term *visual literacy* was first coined in 1969 by John Debes, an important figure in the history of IVLA. Debes offers the following definition of the term:

Visual Literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning. When developed, they enable a visually literate person to discriminate and interpret the visible actions, objects, symbols, natural or man-made, that he encounters in his environment. Through the creative use of these competencies, he is able to communicate with others. Through the appreciative use of these competencies, he is able to comprehend and enjoy the masterworks of visual communication.

The result of this study might easily lead to the conclusion that natural scientists are more visual literate than others. This is only true in the modern view of the image.

Humanists are visually literate. The fact is that we show a great interest in imagery much in the same way that medieval writers and readers did. The religious manuscripts of the Middle Ages are well-known for their beautifully drawn first letters in a chapter. These letters carry meaning outside of being aesthetically pleasing. They include intricate patterns and occasionally drawings that direct the readers associations while reading. Kathryn Starkey does not study religious texts but discusses instead how the vernacular manuscripts from the same time were produced for the courts and trained the audience for visual codes of rituals.

The illustrated manuscript was an important feature of the visual culture of the Middle Ages, nevertheless Starkey stresses that the notion of images was so much broader at that time than today and, what is interesting, that a high degree of visual literacy brought higher status. In her examples she shows that on the one hand, the artists (working together with the writer) chose certain aspects of a tale to be visualised to the audience. The choices they made had to do with interpretation and voicing. Not seldom a storyteller is pictured, thereby visualising the idea of the story being told orally. On the other hand, the language is full of metaphors and long descriptions of clothing and scenes of public performance and display (compare *Nibelungenlied* or *Tristan*). It has been suggested that the medieval texts were illustrated to reach out to different audiences, and that the educated would ruminate on a word, whereas the laymen would look at the pictures. Starkey disagrees to this view and states that there may be two media but not two separate forms of reception, because both texts and images have to be “read”.

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30 Web site of International Visual Literacy Association > visual literacy (March 27, 2008).
This would offer an explanation to why some authors of the investigated theses choose to present a photo of themselves; a picture of the oral narrator. However, the use of self-portraying is not found only in Humanities, but in all areas of the studied material. I believe that the more anonymous the author is expected to be – dictated by genre -the more the author uses the possibility to show her or his personality in the introduction and acknowledgements chapters. This could be observed by the clip arts, decorative\textsuperscript{32} drawings and personal photos found and shown in the Results section.

A Fine Line between Graphics and Written Words

That the study of graphics includes photos, pictures, drawings, maps and charts is not an issue. The question is where written words are seen as something more or something else, and on this border line we find on the one side citations, bullet lists and indented lists that belong to the written language, and on the other side tables, text boxes and equations that belong to graphics.

Any written language that is separated from the normal flow of text and is surrounded by lines or has a reference number is regarded as a graphic. This means that many equations qualified as graphics and were therefore included in this study. It also means that an indented written text with lots of white space around is not seen an illustration, unless it is numberered and this number is mentioned somewhere else for reference in the written text. Secondly, lists, whether decorated with bullets or numbers, are not included in illustrations.

Theoretical Background

As the use illustrations in the context of scientific writing is not a field of its own, I was left to choose a theory structure from the field of visual studies or the field of language studies – or both. I have chosen a sociolinguistic approach, building on the notion that the illustrations used in scientific writing are closely connected to the written language on the same page, and very often, if not always, the illustrations become meaningless when taken out of context. In a scientific context, the illustrations differ from art images in that they explain something and not because of their beauty or aesthetic value. That is why a linguistic model is applicable also to the study of graphics in scientific literature.

\textsuperscript{32} With „decorative“ I mean drawings that do not carry information vital to understanding the study object.
Bazerman’s Genre and Activity Theory

The sociolinguistic approach that I have chosen is the Genre and Activity Theory, as described by Charles Bazerman. He is a professor of English and Education at the University of California in Santa Barbara, and when he was given the task to prepare students to write academic essays in the 1980s, he noticed that he needed an in-depth understanding of how the process of writing works in the different disciplines. Since then, Bazerman has combined his writing of composition reference guides with extensive research on the writing practices in the academic world. Next follows a summary of some of his research results.

It is worth noting that the accomplishment of scientific discourse appears to hide itself, compared to, e.g., poetry, law and newspaper articles, that are apprehended as a product of extremely skilled writers. On the contrary, to write science is commonly thought not to write at all, just simply to record the natural facts. Moreover, scientific activity is often treated apart from other writings as a special code privileged through its reliance on mathematics, which is considered a purer symbolic system than natural language. Bazerman’s research proves people mistaken. All the same, this belief attests to the success of the accomplished system of scientific communication. So much has already been regularized, that using the language seems hardly an effort at all, and has been overseen by linguistic research gone into this field.33

Bazerman distinguishes a genre of general tradition as well as particular tradition within each discipline, a genre that he calls the experimental article. What he teaches in his writing course is that the students must understand and rethink the rhetorical choices embedded in each basic habit to master the genre. The genre helps stabilize the form, and ease choices to be made, and not to lose control. More to the point it is the activity within the disciplines – each new text and each new reading – that reinforces or remoulds the genre.

Furthermore, texts come together as resources and serve as interactive contexts for each new piece of writing so that genres do not stand alone, but rather exist in a systematic relation to one another. Some genres are only meaningful when preceded by another, as a review article. Some genres require responses in other genres, such as an evaluation to a finished course. To focus our attention on these relationships and linkages of genres, Bazerman suggests “we consider genre systems and the way such a system frames each single use of a genre to carry out a set of intentions within systematic relations”.34

The reason why I think Bazerman’s theories fit well with the concerns of this study is that he is concerned with the rhetorical gist of entire texts. Even if he did not intend the combination of illustrations and written language, this is how I choose to use them for this study. The relevant questions that he asks are:

1. What repertoire of concepts and tools can be found?
2. What is an appropriate text in any discipline?

For my conclusions, it is also important to remember the basic questions that were the starting point of his research, and where Bazerman also delivers a straight answer:

1. What is the goal of the study of writing? The goal is helping people to write better.
2. How does writing work? The more we understand how writing works, the more intelligently we can control our choices of linguistic resources available.

The page is no more than a sonata score or a drama script, an archive mediating between an imagined event and a distant realization.

When Bazerman looked at what studies of scientific communication had brought in various disciplines, he realized the full complexity of this interdisciplinary perspective. The work in each discipline is framed around the discussions internal to that field, and to understand the disciplines, you need to encounter them in the context of their own problematics. For example, in one of his studies, Bazerman made a qualitative analysis of articles from the journal Physical Review between 1893 and 1980. In order to discuss the topics of these articles, it is necessary that he understands something about the subject. I gather that he does, but the question is to what extent anyone manages to bridge the gap between natural and social sciences – one human scientist to another.

My study object includes 164 dissertations, published at the University of Uppsala, Sweden, in 2007. These were the monographs placed together in the journal reading room on the 6th floor in the university library of Carolina Rediviva in Uppsala on the 14th and 15th February 2008. This circumstance offered a simple solution to my choice of study objects, as the two most important concerns were (i) to find sources from a wide range of disciplines, and (ii) that the sources be contemporary. Also, about 80 percent of these works are available as pdf-file online with the same library, which enables me to check on details from home when needed. This was not always the case; as a comparison, only 25 percent out of 330 dissertations that were published in 2000 are available online.
Method

An investigation of 164 dissertations was carried out in the Uppsala University Library during two days in February 2008. I examined each and every doctoral thesis, looking for illustrations, be it charts, tables, icons, photos, maps, etcetera. My foremost concern was the appearance of illustrations, not the function, which is important to keep separate, as a chart with a curve can show a rather simple time relationship, whereas another chart with lines includes complicated mathematical expressions.

Aware of my preconceptions that might hinder objectivity, I decided to make notes of a number of any traits that could possibly turn out to be important. I noted (i) the originating department of the dissertation, (ii) the gender of the author (iii) language, (iv) bibliographic features such as number of pages, number of papers, publisher, and availability as a pdf-file online. In a field for commentaries I noted page design features like bullet lists, indents, striking fonts and any other unusual traits. I noted the name of the author only to be able to identify each single dissertation.

When it came to my key concern, the illustrations, I started out with some loose categories such as photo, diagram, line graph, pie and tables, and realised after the first 20 examinations that I needed to double back and make changes until I felt that I had a relevant division of all occurring visuals. It is important to keep in mind that I am concerned foremost with the appearance and not the intellectual content of the illustrations, which may very well mean that an expert of a certain field would object loudly to my classification.

Going through the extensive material of 164 theses, it would have been very time consuming to count all the illustrations. Moreover, I was not sure that an exact count was necessary to meet the ends of the investigation. Thus, I developed my own method of “weighing” the illustrations by ordering them into four main groups:

1) “One” – standing for a single specified illustration, such as table, chart, etcetera
2) “Few” – standing for 2–6 of one specified illustration
3) “Some” – standing for 7–11 of one specified illustration
4) “Lots” – standing for 12–99 of one specified illustration

Writer’s Manuals

From this follows that the groups were given the following values when used in tables: One = 1, Few = 4, Some = 9, and Lots = 15.

In order to answer the questions of this study, I furthermore decided to explore a number of writers’s manuals. These were randomly chosen, in that I went
through 70 copies found on two shelves in the library of the Swiss Federal Institute of Technology in Zürich in January 2008. I wanted to know how the use of graphics was taught to authors in a scientific context and took notes of the extent and depth of the chapters that through their headings signalled such content.

Before turning to the Results and Discussion chapter, I next give an overview of the disciplines as they are ordered by the University of Uppsala and its library. This outline is needed since the order of disciplines vary somewhat from university to university, and Table 1 from time to time, that shows the origins of cited doctoral theses.

Disciplines and Faculties of Uppsala University

The Official Order

The web site of Uppsala University counts three disciplinary domains and nine faculties. These domains are: Arts & Social Sciences, Medicine & Pharmacy, and Science & Technology.

The Faculty of Educational Sciences stands out, as it is listed as a disciplinary domain of its own, without actually being one.35 The University counts nine Faculties: Theology, Law, Arts, Languages, Social Sciences, Educational Sciences, Medicine, Pharmacy, Science & Technology.

All of these faculties are represented in the source material of this study, see break-down in Table 1. However, on closer scrutiny of the table, you will notice that the break-down does not exactly mirror the representation of said three domains and nine faculties. Nor does it exactly mirror the pull-down menu proffered in the university online catalogue, which I will come to presently. This is because during the examination of my source material, the doctoral theses, I recorded the bibliographic details given at the beginning of each volume. These are almost consistent with the cataloguing principles of the university library, and differ somewhat from the presentation on the university main web site.

I mention this fact, as it goes to show that the discipline thinking is not natural but constructed, and the boundaries are floating, so that we can have only a vague idea of which subject belongs to which discipline. In the case of typically interdisciplinary fields, such as Gender Studies or Biochemistry, it is only the combination of the department affiliation of the author on one hand and the subject matter on the other that makes it possible to identify a field of study. Also, it shows that even within the smaller world of a university administration,

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35 Web site of Uppsala University > In English > Faculties, departments (March 16, 2008).
compared to a national perspective, there is no consistent use of academic field names.

The Library Order

I have decided to use the terminology as found in the beginning of each volume that I examined. This means, for example, that Arts & Social Sciences are from now on called Humanities & Social Sciences. Also Biology, Chemistry, Physics, and Technology are placed at a faculty level, without actually having “Faculty of” in their names. The consequence of this is that instead of nine, we in reality deal with no less than 15 faculties, not counting the “Interfaculty Units”.

If you have a special interest in classification, Appendix I\(^6\) shows all the academic field names that are available to the cataloguing expert at the university library. These are consistent with a pull-down menu with not less than 300 headings offered the (overtaxed?) user on the online catalogue.\(^7\)

The point I want to make is that there is no consistent use of denominations within the university campus.

\(^6\) I will give you a task to get you going in the “department jungle”: see if you can find the different origins of Computer Science and Computing Science.

\(^7\) Web site of Uppsala University > in English > Publications (March 24, 2008).
Table 1. Breakdown of the 164 examined doctoral theses ordered by faculty and in alphabetical order.

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>FACULTY</th>
<th>DEPARTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 Humanities &amp; Social Sciences</td>
<td>11 Faculty of Arts</td>
<td>1 Dept of Art History</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Dept of Cultural Anthropology and Ethnology</td>
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<tr>
<td></td>
<td></td>
<td>1 Dept of History</td>
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<tr>
<td></td>
<td></td>
<td>2 Dept of History of Science and Ideas</td>
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<tr>
<td></td>
<td></td>
<td>2 Dept of Literature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Philosophy</td>
</tr>
<tr>
<td>10 Faculty of Languages</td>
<td></td>
<td>4 Dept of English</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Dept of Linguistics and Philology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Dept of Modern Languages</td>
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<tr>
<td></td>
<td></td>
<td>2 Dept of Scandinavian Languages</td>
</tr>
<tr>
<td>2 Faculty of Law</td>
<td></td>
<td>2 Dept of Law</td>
</tr>
<tr>
<td>30 Faculty of Social Sciences</td>
<td></td>
<td>8 Dept of Business Studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Economic History</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Dept of Economics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Education</td>
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<tr>
<td></td>
<td></td>
<td>1 Dept of Government</td>
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<tr>
<td></td>
<td></td>
<td>1 Dept of Information Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Peace and Conflict Research</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Dept of Psychology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Social and Economic Geography</td>
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<tr>
<td></td>
<td></td>
<td>3 Dept of Sociology</td>
</tr>
<tr>
<td>2 Faculty of Theology</td>
<td></td>
<td>2 Dept of Theology</td>
</tr>
<tr>
<td>46 Medicine &amp; Pharmacy</td>
<td>37 Faculty of Medicine</td>
<td>2 Dept of Genetics and Pathology</td>
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<tr>
<td></td>
<td></td>
<td>1 Dept of Medical Biochemistry and Microbiology</td>
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<tr>
<td></td>
<td></td>
<td>4 Dept of Medical Cell Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 Dept of Medical Sciences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Neuroscience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Oncology, Radiology and Clinical Immunology</td>
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<tr>
<td></td>
<td></td>
<td>7 Dept of Public Health and Caring Sciences</td>
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<td></td>
<td></td>
<td>7 Dept of Surgical Sciences</td>
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<tr>
<td></td>
<td></td>
<td>3 Dept of Women's and Children's Health</td>
</tr>
<tr>
<td>8 Faculty of Pharmacy</td>
<td></td>
<td>3 Dept of Medicinal Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Dept of Pharmacy</td>
</tr>
<tr>
<td>1 Interfaculty Units</td>
<td></td>
<td>1 Centre for Clinical Research</td>
</tr>
<tr>
<td>63 Science &amp; Technology</td>
<td>17 Biology</td>
<td>6 Dept of Cell and Molecular Biology</td>
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<tr>
<td></td>
<td></td>
<td>5 Dept of Ecology and Evolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Dept of Physiology and Developmental Biology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 The Linnaeus Centre for Bioinformatics</td>
</tr>
<tr>
<td>15 Chemistry</td>
<td></td>
<td>5 Dept of Biochemistry and Organic Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Dept of Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 Dept of Materials Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Physical and Analytical Chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Dept of Physical Chemistry</td>
</tr>
<tr>
<td>4 Earth Sciences</td>
<td></td>
<td>4 Dept of Earth Sciences</td>
</tr>
<tr>
<td>8 Mathematics &amp; Computer Science</td>
<td>10 Science &amp; Technology</td>
<td>5 Dept of Information Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Dept of Mathematics</td>
</tr>
<tr>
<td>5 Physics</td>
<td></td>
<td>5 Dept of Physics</td>
</tr>
<tr>
<td>4 Technology</td>
<td></td>
<td>4 Dept of Engineering Sciences</td>
</tr>
</tbody>
</table>
As the breakdown in Table 1 shows, the spread of dissertations are roughly one third per faculty, i.e. 55 within Humanities & Social Sciences, 46 within Medicine & Pharmacy, and 63 within Science & Technology. I have decided that this spread is even enough to make comparisons and generalisations about the use of illustrations between the three faculties.
Results and Discussion

Background

The examination of 164 dissertations was carried out in the Uppsala University Library, more precisely the building of Carolina Rediviva, on the 14th and 15th of February 2008. The main objective was to look at the frequency and form of visual representations, and look for a consistent pattern of their use. There were two parts to my inquiry, one dealing with the categorization of the represented illustrations, and one with the categorization of the represented disciplines and faculties. When analysing the results the three main domains of Humanities & Social Sciences, Medicine & Pharmacy and Science & Technology were split up in their six smaller parts. By combining these two perspectives I will be able to test Bazerman’s Genre and Activity Theory by linking the form of illustration with the department it draws from.

Language and Gender

A great majority, 143 theses, were written in English, 20 in Swedish, and one in Norwegian. Of the authors, 79 are women, 76 are men, and 9 authors could not be identified by their first name. The texts in Swedish all belong to the domain of Humanities & Social Sciences whereas all texts within Medicine & Pharmacy and Science & Technology are in English. There are also another 25 theses in English within H&S. There is no striking pattern between gender, language and department affiliation that calls for a more detailed focus of these two aspects.

Graphic Forms and Use

The illustrations found were photos, tables, text boxes, phylogenetic trees, drawings, line charts, column charts, bar charts, pie charts, autoradiographs, chromatographs, diffractograms, spectrograms, micrographs, box plots, maps and equations. Generally it is valid that the illustrations are black-and-white or grey tone, and colour representations are mentioned separately.
At the end of this chapter I introduce the subject of writers’s manuals and the way they treat the matter of illustrations. Kate Turabian and Björn Gustavii are two authors that have devoted special chapters to graphics in their books. The following descriptions of the graphics are in part cited from Turabian’s \textsuperscript{38}, or Gustavii’s manual.\textsuperscript{39} The illustrations are copied from the tools Word and Excel offered by Microsoft Corporation. Where no illustrations are shown in connection with the description, there will be sufficient examples later on.

\textit{Charts}

To the group of charts belong above all bar, column, and line charts that display relationships among the data. Synonyms are “graphs” and “plots”. In addition, there are single apparitions of charts that were not explicitly identified, and they are simply called “other” charts. These are, for example, scatter and area plots and the combinations of charts, as well as autoradiographs, histograms, diffractograms and chronograms.

Bar charts are horizontal, column charts are vertical. Bar charts are useful when you need to fill in longer strings of words. Bar and column charts create strong visual contrasts among individual cases and emphasize comparisons. They also show rank or trend. Bar and column charts can be grouped to show time series, when trend is not that important, and they can be stacked to show relationships within a case. Microsoft also offer the column charts in a cylindrical, conical or pyramid shape, but these were not found at all in the studied material.

Pie charts show 100 percent of something and are best for comparing one segment to the whole; useful only with a few segments or segments that are very different in size. For specific values, it is recommended to add numbers to segments. Pie charts are common in popular venues but frowned on by professionals, says Turabian. That might explain why there were few pie charts in the studied material.

\begin{figure}
\centering
\includegraphics[width=0.8\textwidth]{charts.png}
\caption{Illustration 5. Examples of charts taken from Microsoft Excel. The first row: grouped bar chart, grouped column chart, stacked column chart, and pie chart. Second row: multiple line graph, multiple line graph with data points, multiple area chart, and scatter plot.}
\end{figure}

\textsuperscript{38} Turabian, Kate L., 2007, \textit{A Manual for Writers of Research Papers, Theses, and Dissertations}, p. 95ff.

Line charts are best for showing trends and less emphasize specific values. To show specific values numbers can be added to data points. Area chart are less common as they are known to lead some readers to misjudge values, confusing them with multiple line charts.

A scatter plot is best for showing the distribution of data, especially when there is no clear trend or when the focus is on outlying data points. It compares two variables at multiple data points for a single case.

Illustration 6. Examples of box plots, called stocks in Microsoft Office Excel, followed by two kinds of spectrograms\(^40\), and a chromatogram.

Box plot and spectrogram are types of charts that I chose to keep special track of to see if I could thereby identify a specific genre. They are therefore sometimes mentioned separately in the result tables, and sometimes included in the group called charts. Box plots require four series of values in the order volume-high-low-close or open-high-low-close. Gustavii calls them box-and-whisker plots, where the extensions are meant by “whiskers”. Spectrograms are representations of sounds, and is the result of calculating the frequency spectrum of a compound signal.\(^41\)

Finally, the chromatogram is the output of chromatography, a collective term for a family of laboratory techniques for the separation of mixtures, liquid, gas or other.

**Micrographs**

A micrograph is a photograph-like image taken through a microscope. A micrograph can be a black-and-white image, but quite often it is a colourful depiction.

Colourful micrographs are often beautiful, but the colours themselves have meaning to the researcher. Blue, for example, may show where DNA resides in the cells, red is where there is cytoskeleton (a system of filaments within cells), and green, where there is muscle protein.\(^42\)

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\(^40\) Web site of Oregon Graduate Institute of Science and Technology > Demos > Spectrogram Reading (April 28, 2008).

\(^41\) Wikipedia, the English version, go to: Spectrogram (April 28, 2008).

\(^42\) Web site of Children’s Hospital in Boston > Research > Featured Research > Interactive Features > Make a Micrograph (April 28, 2008).
To the group of micrographs are also autoradiographs, and diffractograms ordered because they look similar, but of course they are made with different techniques and for different purposes, as is the case with the various charts.

An autoradiograph is an image on an x-ray film or nuclear emulsion produced from a distribution of a radioactive substance. Alternatively, the autoradiograph can also be available as a digital image thanks to modern technique that is used above all in Biology, and Medicine for diagnosing purposes.  

Illustration 7. Examples of a micrograph and a diffractogram followed by an autoradiograph in colour.

Photographs
A photograph (or just photo) is made using a camera, and is either in black-and-white, in grey tones or in colour. Photos and drawings bring us in touch with sensuous data.

Drawings
Drawings are apprehended as pencilled lines by hand or computer and are often a result of a combination of techniques (synonymous with computer graphics). Drawings convey the essence of new facts and theories in a visual language. Simply put, this group encompasses all graphics that do not fit in any of the other groups. Synonyms are schematics, diagrams, or pictures, but these terms are not used in order to avoid misunderstanding.

Text Boxes
Text boxes are drawings with geometric forms filled with text. These are circles, ovals, squares and triangles that are often connected with lines or arrows to show a flow, a direction, or a relationship. Thus, text boxes include not only a type of figure often called flow diagram or flow chart, but also include all other instances of geometric forms with letters and words.

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43 Wikipedia, the English version, go to: Autoradiograph (April 29, 2008)
44 From Liebig, A, Dept of Physics (see References, Primary Sources).
45 From Monazzam, A, Dept of Oncology, Radiology and Clinical Immunology (see References, Primary Sources).
Tables
Tables report precise data that would be boring to present in the running text. They vary with the goal of the author. Do they describe an experimental result or do they display results of observations? Order the rows and columns by a principle that let the reader quickly find the message. This ordering principle can be, but must not automatically be, alphabetical.

Maps
A map is a visual representation of an area – a symbolic depiction highlighting relationships between elements of that space such as objects, regions, and themes. Many but not all maps are drawn to a scale, expressed as a ratio such as 1:10,000. Many maps are static two-dimensional, geometrically accurate representations of three-dimensional space. Although most commonly used to depict geography, maps may represent any space, real or imagined, without regard to context or scale. During the last 30 years, the computer has become an indispensable tool for the professional map-maker (cartographer).47

Equations
An equation is a mathematical statement, in symbols, that two things are exactly the same (or equivalent). Equations are written with an equal sign, as in \(2 + 3 = 5\). To solve an equation means to find its solutions. Equations strip nature to its basic regularities, and are often used to state the equality of two expressions containing one or more variables.48 Equations are included as illustrations in this study in those cases where they have reference numbers attached to them.

Graphics in Faculty Context
In the following I present the illustrations as they occur in the different faculties, pointing out features that are the most common on one hand and exceptions on the other. Also I present some statistics of graphics form and frequency on a departmental level disregarded for faculty affiliation. In the following discussion I present some of the activities surrounding the theses that I find relevant, such as library routines, publishing traditions, writers’s manuals, and computer software. These perspectives together will show a more differentiated idea of genre emerging than that of a traditional faculty-thinking.

To begin with, I especially want to guide the reader to Appendix II, which shows a detailed overview of the found illustrations and the frequency with which they occur in each department. There are four levels of frequency: Lots, Some,

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47 Wikipedia, the English version, go to: Maps (April 28, 2008).
48 Wikipedia, the English version, go to: Equation (April 28, 2008).
Few, and One. The more illustrations, the darker the colour, which gives a “feeling” of the density and different types in the various disciplines. By taking a moment to study Appendix II closely, the reader will be able to see for herself the patterns that lead to the conclusions of this study.

Table 2. A summary of the occurrence of illustrations ordered after frequency, and where Lots = 15, Some = 9, Few = 4, and One = 1 (compare Appendix II).

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Charts</th>
<th>Drawings</th>
<th>Tables</th>
<th>Equations</th>
<th>Photos</th>
<th>Text boxes</th>
<th>Micrographs</th>
<th>Box plots</th>
<th>Spectrograms</th>
<th>Maps</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td>111</td>
<td>123</td>
<td>171</td>
<td>11</td>
<td>46</td>
<td>71</td>
<td>43</td>
<td>1</td>
<td>577</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>105</td>
<td>147</td>
<td>51</td>
<td>79</td>
<td>5</td>
<td>4</td>
<td>76</td>
<td>4</td>
<td>24</td>
<td>495</td>
<td></td>
</tr>
<tr>
<td>Social Sci</td>
<td>103</td>
<td>60</td>
<td>164</td>
<td>37</td>
<td>33</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>445</td>
</tr>
<tr>
<td>Biology</td>
<td>77</td>
<td>96</td>
<td>31</td>
<td>59</td>
<td>9</td>
<td>12</td>
<td>29</td>
<td>15</td>
<td>4</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>Pharmacy</td>
<td>72</td>
<td>66</td>
<td>60</td>
<td>6</td>
<td>8</td>
<td>11</td>
<td>18</td>
<td>21</td>
<td>1</td>
<td>263</td>
<td></td>
</tr>
<tr>
<td>Math &amp; Comp</td>
<td>37</td>
<td>29</td>
<td>37</td>
<td>90</td>
<td>8</td>
<td>13</td>
<td></td>
<td></td>
<td>1</td>
<td>215</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>63</td>
<td>58</td>
<td>3</td>
<td>40</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>15</td>
<td></td>
<td>196</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>48</td>
<td>29</td>
<td>8</td>
<td>45</td>
<td>24</td>
<td>4</td>
<td></td>
<td></td>
<td>4</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>Earth Sci</td>
<td>54</td>
<td>19</td>
<td>13</td>
<td>54</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Sci &amp; Techn</td>
<td>30</td>
<td>33</td>
<td>26</td>
<td>18</td>
<td>23</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>Arts</td>
<td>9</td>
<td>4</td>
<td>9</td>
<td>52</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Languages</td>
<td>4</td>
<td>28</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Theology</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Sum Total</strong></td>
<td><strong>709</strong></td>
<td><strong>670</strong></td>
<td><strong>611</strong></td>
<td><strong>430</strong></td>
<td><strong>214</strong></td>
<td><strong>204</strong></td>
<td><strong>131</strong></td>
<td><strong>88</strong></td>
<td><strong>43</strong></td>
<td><strong>16</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 is a condensed version of Appendix II, showing the frequency of illustrations ordered after faculty. The figures are not actual figures but were translated as follows: Lots = 15, Some = 9, Few = 4, and One = 1⁹. The table thus shows the “weight” and frequency of illustrations and although these are inexact numbers, they are still interesting to consider because they offer the following findings:

- Illustrations are most frequent in Medicine (577) and Chemistry (495).
- Social Sciences (445) stands out in this context, since it is nowhere near its alleged faculty neighbours in the Humanities, but instead close to the top illustration users of Medicine and Chemistry.
- In a middle level we find Biology (332), Pharmacy (263) Mathematics & Computer Science (215), Physics (196), Technology (162), Earth Sciences (150), and Science & Technology (131).
- The least illustrations are found in Arts (82), Languages (40), Theology (25) and Law (3).

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⁹ Further explained in the Method chapter.
When we look at the different types of illustrations in Table 2, we see that the charts are the most frequent (709), closely followed by drawings (670). This was expected, as the items cover a lot of different representations. With charts is meant all kinds of plots and graphs that have lines, bars, columns, pie sections or dots and show variables on x- and y-vertices, black-and-white as well as colour. Drawings are similarly a very wide concept, covering all kinds of illustrations that do not fit under any of the other headings. On third place are tables (611), which is a much more straight-forward item, counting all instances of text that was ordered with the help of headings and regular white spaces. Equations are represented on a middle level frequency (430), followed by photos (214), text boxes (204), micrographs (131), box plots (88), spectrograms (43) and maps (16).

Furthermore, we gather from Table 2 that the Faculty of Medicine include top users of charts, drawings and tables. Equations are most common in the Faculty of Mathematics and Computer Science, photos are used equally in both Arts and Medicine, and text boxes occur everywhere. Micrographs are found specifically in the fields of Chemistry, Biology, Pharmacy and Physics, whereas box plots were found in Medicine, Chemistry, Biology and Pharmacy, and spectrograms in Chemistry, Biology and Physics.

That there are no micrographs in the Faculty of Arts and most maps are found in the field of Earth Sciences is hardly surprising but rather consistent with presupposed rules – and therefore not very interesting. The more interesting point is a remarkably wide use of illustrations in the faculty of Social Sciences – unexpected because of the assumed kinship to the “picture-sceptics” in Humanities – and this makes it necessary to leave the faculty thinking and separate the Social Sciences from Humanities, and also make it a main object of study for the discussion of Bazerman’s Genre and Activity Theory.

Finally, Theology stands out with a number of equations and box plots. These are forms of illustrations that are neither expected nor elsewhere present in the Humanities texts.

Next I make a detailed overview of the illustrations as they appear in the different domains, thereby using the terms “lots”, “some”, “few”, and “one”, (in that order) in line with the frequency weighting described in the Method chapter. Colour illustrations are mentioned separately. Except for the statistical data, I sometimes make comments that border on the matter of taste. I allow myself this as the study does not only strive to extract statistical data but also to understand – and bring close to you as the reader – the gist of the different scientific genres.

**Humanities**

The Humanities count 25 theses, whereof 2 (less than 10 percent) are available online. The most obvious common trait is that they are uniformly paginated,
ranging from 145 to 568 pages. An exception to this rule is a thesis from the Dept of Cultural Anthropology and Ethnology, belonging to the Faculty of Arts.

Faculty of Arts

Departments of Art History, Cultural Anthropology and Ethnology, History, History of Science and Ideas, Literature, and Philosophy

The Faculty of Arts is represented with 11 texts (7 percent) from 6 departments. All texts are print only, i.e. they are not available as pdf-files online. It is remarkable to note the varied publishing tradition: 5 texts were published by the university publishing organ, Acta Universitatis Upsaliensis (AUU), 3 were published by external publishing house (whereof 2 in hard cover), one was published by the author, and one by the Dept of Cultural Anthropology and Ethnology. The latter included a main summary text plus 5 papers, in the manner otherwise typical of the natural sciences.50

Five texts contain no illustrations at all. The remaining 6 include (always starting with the most common form of illustration):

- lots of photos, a few drawings, tables, text boxes, line charts, maps, and one colour photo. (No sample available.)

Other features are bullet lists, indents and footnotes that occasionally cover a third of the page.

There are no sample illustrations to show here for the practical reason that none of the texts are electronically available and I did not have access to a scanner to copy any illustrations.

A remarkable book was one of the philosophy theses that gave a very weighty impression, being 352 pages long, without a single illustration and no other page design features such as headings and white spaces. This book clearly follows the tradition of books to be read slowly and thoughtfully, as mentioned by Tebeaux51 – which in reality means that it is unreadable. This faculty shows big differences in the use of illustrations and publishing style.

50 “Natural sciences” is a shorter term for Medicine & Pharmacy and Science & Technology together.
51 See account of the English Renaissance in the introductory chapter.
Faculty of Languages

Departments of English, Linguistics and Philology, Modern Languages, and Scandinavian Languages

The Faculty of Languages is represented with 10 texts (6 percent) from 4 departments. They have a uniform pagination in common, ranging from 145 to 568. All but one are print only. Four texts contain no illustrations at all, the remaining 6 contain:

- lots of tables, a few photos, drawings, and text boxes.

Other often used features are bullet lists and indents.

Table 4.1. Types: distribution across text and gender term categories, normalised per 10,000 words. Raw figures given within parentheses.

<table>
<thead>
<tr>
<th></th>
<th>Cent</th>
<th>Rel</th>
<th>Epic</th>
<th>Occup</th>
<th>Titles</th>
<th>Depr</th>
<th>Appr</th>
<th>RSP</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depo</td>
<td>0.6</td>
<td>1.7</td>
<td>1.7</td>
<td>8.3</td>
<td>2.6</td>
<td>2.2</td>
<td>0.1</td>
<td>1.3</td>
<td>18.6</td>
</tr>
<tr>
<td>Exam</td>
<td>0.5</td>
<td>1.2</td>
<td>1.8</td>
<td>5.9</td>
<td>2.2</td>
<td>1.5</td>
<td>0.1</td>
<td>1.4</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(16)</td>
<td>(24)</td>
<td>(80)</td>
<td>(29)</td>
<td>(20)</td>
<td>(1)</td>
<td>(19)</td>
<td>(196)</td>
</tr>
<tr>
<td>Jour</td>
<td>4.4</td>
<td>5.8</td>
<td>8.0</td>
<td>20.0</td>
<td>13.1</td>
<td>4.7</td>
<td>0.4</td>
<td>9.1</td>
<td>74.3</td>
</tr>
<tr>
<td></td>
<td>(12)</td>
<td>(16)</td>
<td>(22)</td>
<td>(80)</td>
<td>(36)</td>
<td>(13)</td>
<td>(1)</td>
<td>(25)</td>
<td>(205)</td>
</tr>
<tr>
<td>Total</td>
<td>0.5</td>
<td>1.0</td>
<td>1.3</td>
<td>6.6</td>
<td>1.7</td>
<td>1.6</td>
<td>0.1</td>
<td>1.4</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>(13)</td>
<td>(28)</td>
<td>(38)</td>
<td>(186)</td>
<td>(48)</td>
<td>(46)</td>
<td>(3)</td>
<td>(40)</td>
<td>(403)</td>
</tr>
</tbody>
</table>

Illustration 8. Example of a table. (From Lilja, S., Dept of English)

The only example of an included CD was with a thesis from the Dept of English, published by AUU. However, the Dept of English showed an unusually bad working relationship between subject and form in publishing a thesis on Sylvia Plath sporting an ugly page design and no illustrations whatsoever. On the other hand, one of the thesis published by the department of Scandinavian languages presented the most beautiful illustrations in different grey tones. This faculty shows big differences in the use of illustrations and publishing style.

Faculty of Law

Department of Law

The Faculty of Law includes 2 texts from one department, 294 and 366 pages long. Both are print only, one published in hard cover by AUU and the other by the author. The texts include:
• one drawing, text box, and table. (No sample available.)

A notable feature is the great number of footnotes that often cover one third of the page. There are no sample illustrations, as the texts are not electronically available, and I did not have access to a scanner to copy any illustrations.

Faculty of Theology

Department of Theology
The Faculty of Theology includes 2 texts from one department, 248 and 283 pages long. The two texts are very different, in that the first one is print only, published by the department, and the second is available online and published by AUU. The first one has no illustrations, while the second includes:

• lots of tables, some equations, few colour box plots, one drawing, bar chart, text box; and one colour photo.

| Fråga 25 Det finns filmer som getts några insikter som är svåra att sätta ord på |
|---------------------------------|---------------------------------------------------------------------|
| 1( _ ) Stämmer inte alts |
| 2( _ ) Stämmer ganska dåligt |
| 3( _ ) Stämmer varken bra eller dåligt |
| 4( _ ) Stämmer ganska bra |
| 5( _ ) Stämmer helt och hållet |
| 9( _ ) Vet ej |

Om ja, dvs, stämmer ganska bra eller helt och hållet, ge exempel på någon eller några filmer. ....................................................................................................................................................................................................................................................................................................................

Kommentar....................................................................................................................................................................................................................................................................................................................

Illustration 9. Example of a table. (From Axelson, T., Dept of Theology)

Looking at Appendix II, this thesis in Theology stands out in the picture because of the charts and equations. It clearly represents an exception to the rule.

Summary Humanities

One trait worth noticing is the total lack of illustrations in 10 (40 percent) of the theses. (All in all there are another 4 texts from Social Sciences and 1 from Science & Technology lacking illustrations.)

The few illustrations found were tables, text boxes, photos, and drawings. As exceptions to the rule counts one colour photo of the author himself as well as equations in a theology text. Moreover, a book from the English department
offered a CD, and a book from Scandinavian languages offered a pliable colour map in a pocket at the back. These were also exceptions.

Variation is the characteristic of the publishing ways. Twelve texts were printed by the publishing organ of Uppsala University, Acta Universitatis Upsaliensis (AUU), 4 were published by external publishing houses (whereof 3 in hard cover), 6 were published by the department and 3 by the author.

On a personal note there are two texts that well symbolize the extreme poles of variation of representation found, and they may also stand as symbols for the free style of the Humanities. One is a text from the Department of Modern Languages that is without question the least attractive. It was published by the author herself, by printing on and stapling together 233 white A4-sized sheets of paper. Lacking illustrations, the only kind of page design is 12 lists of words, that I called tables because they are surrounded by black frames. This thesis is not available online and therefore I cannot show any excerpts of it, and you have to believe me that it is ugly.52 The most beautiful thesis on the other hand, is a monograph from the Department of Literature with expert choices of colour and text structure. This book is expertly published in hard cover and has all the looks of a novel, including a photo and a presentation of the author at the back.53 In comparison, the theses from the domains of Social Sciences, Medicine & Pharmacy, and Science & Technology are much more conformed and the difference in style is considerably smaller.

Social Sciences

Faculty of Social Sciences

The Faculty of Social Sciences counts 30 theses from 10 departments, whereof 60 percent is available online. A uniform pagination in common, ranging from 121 to 421 pages, is presented in 17 theses, whereas 13 show a different layout, including a summary of on average 70 pages, plus 3 to 4 essays, mostly with separate paginations, as otherwise seen within the Natural Sciences. However, before going into detail of the departments that feature essays, I start with two departments that avoid illustrations as much as the Humanities.

52 Valijärvi, R-L, Dept of Modern Languages (See References, Primary Sources).
53 Lönngren, A-S, Dept of Literature (See References, Primary Sources).
Departments of Sociology and Peace and Conflict Research
The Department of Sociology offer 3 theses ranging from 204 to 328 pages. These were published by AUU or the department and include no illustrations. Page design features such as bullet lists, indents, white spaces and footnotes are used to break up the text.

The Department of Peace and Conflict Research present 2 theses with 216 and 421 pages, both print only, published by the department. One has no illustrations, and the second

- lots of tables. (No sample available.)

Department of Economics
The 4 theses originating from the Department of Economics all have the same layout, i.e. a summary text together with 3 or 4 essays. The texts are uniformly paginated and range from 121 to 154 pages. Two were published within the department and two by AUU. However, only 1 of 4 is available as pdf-file online. The texts include:

- lots of charts and tables, some text boxes, equations, and a few drawings.

One text includes one of the few pie charts found in the source material. Another includes tables that are too big to fit within normal page margins. A third has very complicated charts that are difficult to read. All of this possibly suggests a less professional way to deal with illustrations. No samples can be shown from the texts that are print only. However, illustration 10 shows two samples from the one text that is available online.

Illustration 10. Example of a chart featuring crossed lines and spots, as well as a line chart that rather looks more like a spectrogram. (From Kjellberg, D, Department of Economic Studies)
Department of Psychology
The 5 theses from the department of Psychology show the same typical lay-out otherwise found within the natural sciences, i.e. a summary of about 80 pages and 3 or 4 essays to go with them. All were published by AUU and all are available as a pd-file online, which conveys a more up-to-date touch than the Department of Economics. The illustrations used are:

• lots of charts, some tables and text boxes, drawings and photos.

![Illustration](image)

**Figure 2.** Displays for the hole-fitting task of Study 1.

*Illustration 11. Example of photo showing laboratory settings. (From Örnkloo, H, Department of Psychology)*

![Table](image)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th></th>
<th>Correlations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SDO</td>
<td>1.79 (0.55)</td>
<td>.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Sex</td>
<td>0.45 (0.50)</td>
<td>.12**</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Femininity</td>
<td>3.96 (0.49)</td>
<td>-.19**</td>
<td>-.13**</td>
<td>.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Masculinity</td>
<td>3.41 (0.57)</td>
<td>.12**</td>
<td>.10*</td>
<td>-.03</td>
<td>.80</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, Sex: woman = 0, man = 1.

*Illustration 12. Example of colour table in green and black. (From Snellman, A, Dept of Psychology)*
Illustration 13. Example of drawing that could also be taken for a chart. (From Kochukhova, O, Dept of Psychology)

Illustration 14. Example of "other" chart. (From Kochukhova, O, Dept of Psychology)

Department of Business Studies
Of 8 theses from the Department of Business Studies, 6 show a uniform pagination ranging from 178 to 259 pages, and 2 theses include a summary of about 50 pages plus 4 essays. All but one self-printed text were published by AUU and only three are available as a pd-file online. The illustrations present are:

- lots of tables, some text boxes and equations, a few drawings, and charts.

In one of the theses another of the rare pie charts is found. One thesis is very sophisticated with black pages with white font to separate the chapters. Otherwise simple tables and drawings that are a touch too complicated so that they might rather impair understanding instead of ease it.
Illustration 15. Example of line chart with data points. (From Johed, G, Dept of Business Studies)

Figure 1: The SPI index and household savings in shares and mutual funds as compared with bank savings.

Illustration 16. Example of multiple line chart. (From Johed, G, Department of Business Studies)

Figure 2: The development of households' portfolios 1995 - 2005.

Department of Social and Economic Geography
Another thesis with the feature of essays originates in the department of Social and economic geography and consists of 44 pages plus 4 essays. The second thesis is uniformly paginated and includes 194 pages. Both are available online. The illustrations are:

- lots of charts and tables, a few drawings, maps and text boxes.
Illustration 17. Example of combined column and line chart as well as a map of Sweden. (From Bienkowska, D, Dept of Social and Economic Geography)
The Department of Information Science offers 1 thesis, 72 pages long plus 4 papers, published by AUU and available online, with:

- some drawings, a few photos and charts.

Illustration 18. Examples of clip arts (in acknowledgements), as well as photos, a chart and a colour drawing (From Forsell, C, Dept of Information Science)
Departments of Economic History, and Government

The Department of Economic History offers 2 theses, 158 and 276 pages long (one available online) and the Department of Government offers 1 thesis, 194 pages, published by AUU, available online, and together they include:

- lots of tables, some charts, and one text box.

Table 1: *Hits on the term ‘innovationssystem’ in the newspaper database Affärsdata, 1990–2006.*

<table>
<thead>
<tr>
<th>Total number of articles</th>
<th>Articles dealing with the research funding reform process</th>
<th>Articles not dealing with the research funding reform process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1999</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2000</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>2001</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>102</td>
<td></td>
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<tr>
<td>2003</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>72</td>
<td></td>
</tr>
</tbody>
</table>

Source: Affärsdata (www.ad.se).
Comments: Articles from 104 Swedish newspapers, as well as from Swedish news agencies and press releases, have been included in the search. Duplicates were removed.

*Illustration 19. The one single illustration in this thesis was a table copied from a magazine.*
*(From Eklund, M, Dept of Economic History)*
Tabell 3.6. Antal medlemskap fördelat på fyra föreningskategorier. genomsnitt

<table>
<thead>
<tr>
<th>Föreningstyp</th>
<th>Infödda...</th>
<th>Invandrade födda i...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>utan utländsk bakgrund</td>
<td>med utländsk bakgrund</td>
</tr>
<tr>
<td>Politiska intresseföreningar</td>
<td>0,34</td>
<td>0,33</td>
</tr>
<tr>
<td>Ekonomiska intresseföreningar</td>
<td>1,67</td>
<td>1,65</td>
</tr>
<tr>
<td>Solidaritetsföreningar</td>
<td>0,25</td>
<td>0,25</td>
</tr>
<tr>
<td>Hobbyföreningar</td>
<td>0,71</td>
<td>0,65</td>
</tr>
<tr>
<td>Summa</td>
<td>2,97</td>
<td>2,88</td>
</tr>
<tr>
<td>N</td>
<td>1025</td>
<td>168</td>
</tr>
</tbody>
</table>

Kommentar: MBU 2003. Föreningstypen "Annan förening" ingår inte i analyserna. Asteriskerna avser skillnaden i förhållande till kategorin infödda utan utländsk bakgrund. ** p < 0.01, * p < 0.05, tvåsidigt test.

Illustration 20. Example of one of as many as 61 tables. (From Myrberg, G, Department of Government)

**Figur 1.1. Tänkta orsaksamband mellan föreningsdeltagande, politiskt engagemang och olika bakgrunds faktorer, inklusive invandrarskap**

Illustration 21. Example of the one figure with text boxes. (From Myrberg, G, Dept of Government)

The Department of Education
The Department of Education offers 2 theses, 237 and 400 pages long, published by AUU and available online (>2MB each). These include:

- lots of photos, drawings, some tables, and a few charts.
Illustration 22. Examples of a child’s drawing and a photo. (From Fast, C, Dept of Education)

Figur 6. Schematisk skiss över de fyra rummens doxor respektive logik samt skiss av habiliteringsrummet.

Illustration 23. Example of a drawing. (From Carlhed, C, Dept of Education)
Summary Social Sciences

The Department of Sociology is close to the Humanities in the way the authors present long texts with no illustrations. One text looked exactly like one from Law with footnotes covering a third of each page. Another was professionally designed in hard cover with a photo and presentation of the author at the back, much like the Literature thesis mentioned above. The Department of Peace and Conflict Research also lacked illustrations except for tables.

Economics and Psychology, on the other hand, show a conformity and specificity very similar to the genre of Natural Sciences, in the way their theses, without exception, build on a summary followed by a number of papers – here called “essays”. However, in Information Science, the parts are called papers. The illustrations are more varied in Psychology and Information Science, as well as in Education (using colour drawings and photos) than Economics, Economic History and Government, where traditional tables and charts dominate.

Business Studies and Social and Economic Geography show a mixed tradition, occasionally offering essays, but more often long texts with few illustrations, theses that are not available online. I keep mentioning this, because I am surprised that some people are not using the possibilities of open source and making available their research results, if not for the good of all mankind, then for the citation indices. I will come back to the subject of open source in connection with a discussion about library routines. In the meantime, I think it is worth noticing, that also long texts, including a number of illustrations, like those of Education, are uploaded as pdf-files, although they reach a weight of about 2MB. If heavy documents are not a problem, what is it then? 14 texts were published by AUU, 15 by respective department, and 1 was published by the author.

Finally, similar to Humanities, typical are tables, text boxes, photos and drawings, with the difference that charts take the lead. The charts come in the form of multiple lines, columns, spots, pies, or “other”. Graphics in colour (drawings, photos, charts, in that order) are also slightly more common than in the Humanities. There is even a first instance of clipart on a private note. We shall see more of that as we move on to the natural sciences, starting with Medicine.
Medicine

Faculty of Medicine

Departments of Genetics and Pathology, Medical Biochemistry and Microbiology, Medical Cell Biology, Medical Sciences, Neuroscience, Oncology, Radiology and Clinical Immunology, Public Health and Caring Sciences, Surgical Sciences, Women’s and Children’s Health

The Faculty of Medicine includes 37 texts from 9 departments, conforming in style with a main summarizing part, on average 66 pages, together with 3 to 6 papers. All texts are published by AUU, whereof 92 percent are available online. The theses include the following illustrations:

- lots of autoradiographs, line charts; lots of colour tables, some photos, drawings, tables, text boxes, micrographs, box plots; some colour drawings, colour micrographs, colour bar charts, a few pie charts; a few colour photos, colour text boxes, colour pie charts, colour bar charts, one map; one colour map

![Diagram](image)

*Figure 7. IFN-inducible genes are produced through JAK/STAT signaling which is activated by IFN-alpha.*

*Illustration 24. Example of colour drawing (75 percent ratio). (From Linga Reddy, M, Dept of Genetics and Pathology)*
Figure 1. Chemical structure of 1400W.

Illustration 25. Example of b/w and colour drawings. (From Rydgren, T, Dept of Medical Cell Biology)

Figure 2. Schematic outline of an IL-1 trap (modified from ref. 77).

Illustration 26. Example of charts not legible in print (copied at 100 percent ratio). However, the pdf page can be sized-up to e.g. 200 percent, which makes the illustration legible. (From Hu, L, Dept of Medical Sciences)

Figure 5. Gamma-like HERV expression in normal endometrium and ovarian tissue. Samples were processed and data were analysed as in Figure 3.
Illustration 27. Examples of a MicroPET scan image, a colour drawing, and an autoradiogram. (From Lendvai, G, Dept of Medical Sciences)

Illustration 28. The drawing of a jumping woman (clip art) was placed alone on a page immediately before the introductory chapter. (From Arnell, K, Department of Surgical sciences).
Illustration 29. The hearts were placed in acknowledgements and the apple (twice the represented size) decorates a page at the end without further comments. (From Warensjö, E, Dept of Health and Caring Sciences)

Summary Medicine

The Faculty of Medicine is the single most dominating in this study with 23 percent of the theses, before that of Social Sciences which is present with 18 percent. This adds to the effect that Medicine is very rich with illustrations, because even as each thesis is studied on its own, when there are lots and lots of graphics in a whole line of theses, the effect is naturally stronger than in the case of just a few theses. Please keep this in mind when looking at the results tables.

The theses are shorter than those of Humanities and Social Sciences, which means that the text is much more condensed, as graphics take up much more page space. Gustavii gives an example of the language tradition within “the medical and biological sciences”, where 55 words can be turned into 15. The too many words only obscure meaning, Gustavii states. The (i) long version and (ii) versions run as follows.54

(i) Our research, designed to test the fatal effects of PGF2α on dogs, was carried out by intravenously introducing the drug. In the experiments, a relatively small quantity, 30 mg, was administered to each animal. In each case, PGF2α proved fatal; all 10 dogs expiring before a lapse of five minutes after the injection.

(ii) Intravenous injection of 30 mg prostaglandin PGF2α to each of ten dogs killed them within five minutes.

I speculate that this strict language use moves the author to include a personal illustration (self-portrait or clip art) where still allowed in order to show the narrator behind the story – in line with the medieval vernacular texts (see Introduction section). There is both a lot of variation and a great number of graphics in the Medicine theses. A strong feature is colour, sometimes used to convey singular information, and sometimes not. Typical for Medicine are the autoradiographs and the micrographs. Worth noticing is also the clip art, i.e.

54 Gustavii, 2003, p. 5.
ready-made drawings, that some authors choose to include at the beginning or end of their reports and in connection with acknowledgements.

Pharmacy

Faculty of Pharmacy

*Departments of Medicinal Chemistry, Pharmacy, and Centre for Clinical Research*

The Faculty of Pharmacy includes 9 texts from 3 departments, and these include a main part of about 75 pages, followed by 4 to 6 papers. All texts are published by AUU and are 100 percent available online. They include:

- lots of tables, some drawings, line charts, other charts, micrographs; some colour drawings, a few photos, text boxes, bar charts, box plots, equations; few colour photos, colour line charts, one colour map.

*Illustration 30. Example of 3D colour drawings as well as four chromatograms. (From Hermann, A, Dept Medicinal Chemistry)*
Summary Pharmacy

Compared to Medicine, the Pharmacy theses do not have on average as many illustrations, however, similar are the great variety of forms, as well as the mix of black-and-white and colour graphics, sometimes even on the same page. Typical are tables, drawings and charts. The use of equations might suggest a closer relevance to Science and Technology than to Medicine, where no equations were found.

Typical is also that some of the papers are copies of articles printed in columns, in the style of periodicals, and that thereby the quality of the illustrations is sometimes bad and the explanatory illustration texts illegible. This is surprising, as one assumes that it is of outmost importance for the author that her or his arguments be rightly understood. My speculation is that the world of open source, i.e. that the document is available for retrieval on internet, and the quality can be improved through e.g. magnifying (zooming), has lessened the need of high print quality.
Science

Biology

Departments of Cell and Molecular Biology, Ecology and Evolution, Physiology and Developmental Biology, Linnaeus Centre for Bioinformatics

Biology includes 17 texts from 4 departments that all consist of a main summary of about 58 pages followed by 4 to 7 papers. All theses are published by AUU, except one that was published by the department of Mathematics and Computer Science (with a Biology connection through the Linnaeus Centre), and they are 100 percent available online. They have the following illustrations:

- lots of drawings, equations; lots of colour drawings, some micrographs, box plots, tables, a few text boxes, line charts, column charts, maps; a few colour photos, colour column charts, colour line charts, colour spectrograms, colour micrographs.

Illustration 32. A strip found alone on a page at the beginning of a thesis - copied at 80 percent ratio - with no references to the origin (which the author happens to know is a Swedish comic called “Rocky” by Martin Kellerman.) (From Toräng, P, Dept of Ecology and Evolution)

Illustration 33. Example of box plot. (From Toräng, P, Dept of Ecology and Evolution)
constants were generally not estimated from fitting the Michaelis-Menten equation (1) to the data points.

\[ v = \frac{V_{\text{max}}[S]}{K_m + [S]} \]  

(1)

Instead the data were plotted in a Hanes-Woolf plot with \([S]/v\) against \([S]\).

Illustration 35. Example of equation, which has no figure text of its own, but is nevertheless numbered, a number that serves as reference in the flowing text. (From Roos, A K, Dept of Cell and Molecular Biology)

Figure 10. Typical features of the DNA Hoechst staining in cells exposed to (A) DMSO, (B) 3-MeSO₂-DDE (20 µM) or (C) the apoptosis-inducer staurosporine (1 µM).

Illustration 36. Example of micrographs (From Lindström, V, Dept of Physiology and Developmental Biology)
Some examples of compensatory evolution \textit{in vitro} and \textit{in vivo} are listed in Table 3.

Illustration 37. Example of text box that breaks up the flowing text and highlights some data shown in tables, reminding of the text boxes found in newspaper articles and which are added for effect. (From Komp Lindgren, P, Dept of Cell and Molecular Biology)

Illustration 38. Example of drawings. It does not say who made them. (From Abrahamson, A, Dept of Physiology and Developmental Biology)

\textbf{Figure 3.} The gill filament EROD assay: dissection of gill arches from rainbow trout, preparation of primary filament tips, incubation in a well of a tissue-culture plate, and aliquot sampling and transfer to a 96-well plate.

Illustration 39. Example of colour photos. (From Abrahamson, A, Dept of Physiology and Developmental Biology)

Illustration 40. Example of 2D drawings of molecular structures. (From Abrahamson, A, Dept of Physiology and Developmental Biology)
Chemistry

Departments of Biochemistry and Organic Chemistry, Chemistry, Materials Chemistry, Physical and Analytical Chemistry, Physical Chemistry

Chemistry includes 15 texts from 4 departments that include a main summary of on average 66 pages, and 4 to 7 papers. All theses were published by AUU and are 100 percent available online. They include:

- lots of drawings, micrographs, equations; lots of colour drawings, some tables, line charts, autoradiographs, spectrograms; some colour line charts, a few photos, text boxes, column charts, box plots; a few colour photos, colour tables, colour column charts.

Table 2. $^1$H hfcc values (in Gauss) for N$^+$ and CHT$^+$ as computed with B3LYP/6-311+G(d,p) and MP2/6-311+G(d,p). Pictures are provided for both compounds with selected bond distances (in Ångström) and angles as optimized at the two levels of theory (MP2 within parentheses).

<table>
<thead>
<tr>
<th>Proton</th>
<th>1a, 1b</th>
<th>2.5</th>
<th>3, 4, 6, 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>B3LYP</td>
<td>4.2</td>
<td>−0.5</td>
<td>−7.2</td>
</tr>
<tr>
<td>MP2</td>
<td>3.0</td>
<td>−0.7</td>
<td>−8.5</td>
</tr>
<tr>
<td>Exp.$^a$</td>
<td>3.28</td>
<td>0.58</td>
<td>7.98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proton</th>
<th>1a, 1b</th>
<th>2.7</th>
<th>3.6</th>
<th>4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B3LYP</td>
<td>51.2</td>
<td>−6.9</td>
<td>−0.7</td>
<td>−4.7</td>
</tr>
<tr>
<td>MP2</td>
<td>56.9</td>
<td>21.4</td>
<td>2.8</td>
<td>−12.3</td>
</tr>
<tr>
<td>Exp.$^b$</td>
<td>51.5</td>
<td>51.5</td>
<td>5.7</td>
<td>—</td>
</tr>
</tbody>
</table>

$^a$ $^1$H hfcc values assigned to an ESR spectrum of N$^+$ in a zeolite matrix at 175 K.$^{65}$

$^b$ $^1$H hfcc values assigned to an ESR spectrum of CHT$^+$ in a CF$_2$CICFCI$_2$ matrix at 77 K.$^{72}$

Illustration 41. Example of a table in combination with drawings. (From Norberg, D., Dept of Physical Chemistry)
Figure 15. The NMR-derived secondary structures for the (a) native and (b) modified dodecamer. The native and modified residues in the central four base pairs are shown in blue and red, respectively.

Illustration 42. Example of coloured DNA helix against black background. The figure text refers to the colours as carrying information. (From Pathmasiri, W, Dept of Biochemistry and Organic Chemistry)

Illustration 43. Example of drawing. The figure text does not say who made the drawing. (From Alm, O, Dept of Materials Chemistry)

![Diagram](image)

Figure 1.1: The general layout of the LCVD reactor used for deposition of nanoparticles.

Illustration 44. Example of equation, no figure text but numbered for reference. (From Alm, O, Dept of Materials Chemistry)

\[
n_p \propto \frac{1}{\lambda^{5.54}} \cdot \frac{1}{\exp(hc / \lambda k_B T) - 1}
\]

Illustration 44. Example of equation, no figure text but numbered for reference. (From Alm, O, Dept of Materials Chemistry)
Table 3.1: The polymorphs of bulk $\text{WO}_3$ that appear in the temperature region 0 – 1173 K. In the overlapping temperature regions phase mixtures exists [90].

<table>
<thead>
<tr>
<th>Polymorph</th>
<th>Structure</th>
<th>Space group</th>
<th>Temperature range (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varepsilon$-$\text{WO}_3$</td>
<td>monoclinic</td>
<td>$P\overline{2}$</td>
<td>0 - 230</td>
</tr>
<tr>
<td>$\delta$-$\text{WO}_3$</td>
<td>triclinic</td>
<td>$P_1$</td>
<td>232 - 288</td>
</tr>
<tr>
<td>$\gamma$-$\text{WO}_3$</td>
<td>monoclinic</td>
<td>$P_{21}$</td>
<td>288 - 498</td>
</tr>
<tr>
<td>$\beta$-$\text{WO}_3$</td>
<td>orthorhombic</td>
<td>$P_{\text{mnb}}$</td>
<td>598 - 1173</td>
</tr>
<tr>
<td>$\alpha$-$\text{WO}_3$</td>
<td>tetragonal</td>
<td>$P_{\text{dmma}}$</td>
<td>1013 - 1173</td>
</tr>
</tbody>
</table>

Illustration 45. Example of table. (From Alm, O, Dept of Materials Chemistry)

Illustration 46. Example of diffractograms. (From Alm, O, Dept of Materials Chemistry)

Figure 4.2a: XRD diffractogram ($\text{CuK}_\alpha$-radiation) showing both $\alpha$-Fe and $\gamma$-Fe content of a nanoparticle film as synthesized in 10 mbar of $\text{Ar}$ ($\phi = 100 \text{ mJ/cm}^2$). Grey line corresponds to best pseudo-Voigt fit of the double peak. Figure 4.2b, XRD diffractogram ($\text{CuK}_\alpha$-radiation) of a Co nanoparticle film ($\phi = 160 \text{ mJ/cm}^2$). The broadened peaks of the strongest reflections of the $\alpha$-Co and $\beta$-Co are not resolved.

Illustration 47. Example of a micrograph. (From Alm, O, Dept of Materials Chemistry)

Figure 4.14: Co particles deposited at 220 mJ/cm$^2$. In these high fluence region particles with partly evaporated metallic core were observed.
Illustration 48. Examples of the various graphics in one and the same thesis, from left to right, top to bottom of (i) a Raman spectra, (ii) a cross-sectional TEM micrograph, (iii) a colour drawing with red and blue atoms, and (iv) an equation. (From Wilhelmsson, O, Dept of Materials Chemistry)

Earth Sciences

Department of Earth Sciences
Earth Sciences include 4 texts from 1 department with a main summary of on average 73 pages, and 4 to 6 papers. All theses were published by AUU and are 100 percent available online. They include:

- lots of equations; lots of colour drawings, some tables, maps; some colour maps, a few drawings, column charts, one colour photo.
Illustration 49. Examples of charts showing wave velocity, and 2 equations. (From Schelzbach, C, Dept of Earth Sciences)

\[
\rho \frac{\partial^2 \mathbf{u}}{\partial t^2} = (\lambda + 2\mu) \nabla (\nabla \cdot \mathbf{u}) - \mu \nabla \times (\nabla \times \mathbf{u})
\]

\[
O(s) = \delta \mathbf{t}^T C^{-1} \delta \mathbf{t} + \\
\lambda [\alpha (s^T W_h^T W_h s + s_2 s^T W_p^T W_p s) + \\
(1 - \alpha) (s - s_0)^T W_p^T W_p (s - s_0)]
\]

Illustration 50. Example of charts with a function. (From Sahlée, E, Dept of Earth Sciences)

Figure 8 Examples of dimensionless w-θ cospectra as a function of normalized frequency. Filled circles represent unstable conditions, open circles represent UVCN-conditions. Subfigure a) shows measurements at a land site, b) shows measurements from the marine site Östergarnsholm.

Illustration 50. Example of charts with a function. (From Sahlée, E, Dept of Earth Sciences)
Physics

Department of Physics
Physics include 5 doctoral theses from 1 department that have a main part with an average of 85 pages and 6-17 (seventeen) papers. They were all published by AUU and are 100 percent available online. They include:

- lots of drawings, line charts, equations; lots of colour drawings, lots of colour line charts, some colour spectrograms, a few photos, tables, text boxes, spectrograms, micrographs, other charts; a few colour other charts, one colour photo.

Illustration 51. From left to right, top to bottom we see (i) a colour device drawing, (ii) an equation, (iii) a structure text box, (iv) a phase diagram, (v) a line chart, (vi) a repeated zone illustration. All illustrations copied at a 50 percent ratio. (From Skubic, B, Dept of Physics)
Summary Science

Science includes 24 (15 percent) of the investigated theses, and 100 percent are available online. All four faculties of Biology, Chemistry, and Earth Science and Physics – similar to Medicine and Pharmacy – present a variety of illustrations, in black-and-white as well as in colour. It is interesting to note that a thesis in Biology was actually published by the Department of Mathematics. The text includes a lot of equations and geometrical figures in a way that would suggest the genre of Mathematics. However, there are also equations in other Biology work so in this case there is no clear signal of origin of genre. Nevertheless, institutions such as the Linnaeus Centre that enables interdisciplinary cooperation offers a good site to study the origins and domination of genres.

Typical for all four faculties are spectrograms and also autoradiographs, micrographs and equations. Exceptional for Chemistry are the drawings of DNA double helices. As expected, Earth Sciences offers a number of maps.

On a personal note, Chemistry and Physics are the fields that offer the most breath-taking computer graphics. They are not as much carriers of true facts, but ideas of reality on a micro or macro level, i.e. these graphics depict a reality that can not be seen with the human eye and can only be imagined. Moreover, they reveal a pleasure for spectacular colours and forms that probably have been encouraged and reinforced by the high media interest of its topics.

![Illustration of computer graphic](image-url)

**Fig. 6.1** Ett vattenlager som omger en våte-termindr diamantiyta. Om förhindrandet är gynnsamt så överförs elektroner spontant från diamantytan till vattenlagret och reducerar det. Kvar lämnas då hål i diamantiyten och dessa hål kan leda en elektrisk ström.

*Illustration 52. Example of computer graphic (at a 75 percent ratio). (From Petrini, D, Dept of Materials Chemistry).*
Technology

Mathematics and Computer Science

Departments of Mathematics, and Information Technology
Mathematics and Computer Science includes 8 dissertations from 2 departments, whereof 6 texts have an average of 71 pages and 3-7 papers (one of these have a uniform pagination that add up to 262 pages). The remaining 2 have no papers and enclose 226 and 231 pages respectively. Four theses were published by AUU, and 4 by the department. All but one are available online. The texts include:

- lots of tables, equations, some drawings, text boxes, other charts; some colour drawings, a few photos, line charts; a few colour photos, colour line charts, colour other charts, one colour map.

![Figure 2.1: The grid (solid lines) and the dual grid (dashed lines) in two dimensions.](image)

This work was funded by the Graduate School in Mathematics and Computing.

Illustration 53. Example of a drawing, “other” colour chart, logo and text of a sponsor found in “Acknowledgements”, and an example of a complicated colour computer graphic – here copied at a 50 percent ratio, but barely legible also at a 100 percent ratio. (From Gong, J, Dept of Information Technology)

The Faculty of Science and Technology

Department of Evolution, Genomics and Systematics
The Faculty of Science and Technology includes 10 theses from 1 department. The texts contain a summary part of on average 51 pages, and 4-7 papers. All theses were published by AUU and all are available online. They have:
• lots of other charts, some photos, drawings, tables, text boxes; some colour
drawings, a few line charts, maps; a few colour photos, colour tables, colour
line charts, one box plot; one colour text box.

Illustration 54. From left to right, top to bottom: a clip art (running man) decorating “Aims”, a
micrograph of a plant, two photos from water falls (one text says: “And the fantastic nameless
water fall at the Troms Tverreleven!”), and finally a clip art (sun) in “Acknowledgements”. (From
Savić, S, Dept of Evolution, Genomics and Systematics)

Illustration 55. Example of colour drawing. (From Anderson, C L, Dept of Evolution, Genomics
and Systematics)
5.1.3.1 *Rickettsiaceae* phylogeny

![Phylogenetic tree of Rickettsiaceae](image)

**Figure 5.1** Ribosomal phylogeny of *Rickettsiaceae* inferred with PHYLIP from 26 ribosomal genes in species aligned as peptides with Chantoab. Genes are aligned individually and concatenated, bootstrap 10000, pleistocene, neighbor and consensus. Genes are: *rpsL*, *rpsA*, *rpsE*, *rpmB*, *rpmC*, *rpmD*, *rpmG*, *rplE*, *rplF*, *rplM*, *rpsC*, *rpsB*, *rpsL*, *rpsE*, *rpsG*, *rpsP*, *rpsS*, *rpsD* and *rplJ*. The blue groups are by order: Spotted fever group, transitional group, typhus group and ancestral group. Red in red refer to the DDB1 database. The gene groups refer to the DDB1 database.

**Figure 3.5** Ratio rating matrix of a set of seven genes and three groups, A, B and C

*Illustration 56. A sample of a phylogenetic tree and the single example of a matrix found in the studied material. (From Fuxelius, H-H, Department of Evolution, Genomics and Systematics)*

**Technology**

*Department of Engineering Sciences*

Technology includes 4 theses from 1 department that all include a summary part of about 60 pages and 5-11 papers. All texts were published by AUU and are available online. They include:

- lots of drawings, line charts, equations; lots of colour photos (or computer graphics), some other charts; some colour column charts, a few tables, text boxes; a few colour drawings, colour maps.
\[ \mathbf{F} = \oint \mathbf{F} \cdot \mathbf{dS} \, . \]

Summary Technology

In the smaller domain of Technology I have included Mathematics & Computer Science, Science & Technology, and Technology (terms that fully reveal the problem of designation). Together they include 22 (13 percent) of the theses. All but one are available online, and the conforming structure of summary and papers is put to a test in Mathematics & Computer Science.

Exceptional for the Department of Evolution, Genomics and Systematics are the phylogenetic trees, as well as creative drawings with emotionally coloured comments and exclamation marks. The Department of Engineering stands out.
with a great variety of illustrations and above all lots of drawings – from simple pencilled lines to complicated computer graphics in colour.

Finally, to compare the use of illustrations within the whole of Science & Technology the illustrations show variation in two ways. On one hand there is a great diversity as well as frequency of illustrations in all faculties, and the use often spill over the boundaries, so that you find the same sort of molecular structure drawings in Biology, Chemistry and the Faculty of Science and Technology. Also equations, maps and micrographs are similar. On the other hand theses within the same department vary a lot in that some show illustrations on every page whereas others hardly show any at all. This can be observed in Biology, Faculty of Science and Technology, and Mathematics and Computer Science. Exceptional with the latter is that one of its theses includes no illustrations at all. It is also the shortest one in the study material with only 16 pages summary plus 3 papers.55 (Paradoxical enough the subject is “visualisation in the history of mathematics”.)

The Use of Colour

When looking especially at the use of colour graphics, there are no surprising trends, which means that where I have already demonstrated a great variety and/or frequency of drawings, the use of colour graphics follows.

If we imagine that we stand on a bridge starting with Humanities at one end, and walk towards Technology at the other, with the remaining four domains in between, it so happens that we also walk from black-and-white (b/w) and grey tones to an increasing number of colour graphics of all kinds, be it photos, drawings, maps or charts; tables and equations excepted. The maximum application is found in Science in the neighbourhood of Medicine, Biology, Chemistry and Physics.

In Humanities there is one single instance of a colour photo (of the author). In Social Sciences, there is a little more: 7 theses show colour graphics from the departments of Education, Information Science and Psychology. These are colour photos, drawings and charts, and in addition Psychology shows a few tables framed in green.

In Medicine we find, except those already mentioned, the addition of colour micrographs, text boxes, a few pie charts and a map. The distribution is uneven within the departments, so that in half of the texts there are several colour graphics, and in others none at all, as for example in Medical Sciences. Also, the

55 Pejlare, Johanna, 2007, Dept of Mathematics (see References, Primary Sources).
texts from Department of Public Health and Caring Sciences lack colour photos and drawings; instead they present colour charts and tables.

This either suggests that it is up to the authors how they present their topics, or that within a field one specific topic generates (the need for) colour graphics whereas another does not. To know which is right, an in-depth study of a few theses would be necessary. In the case of this study, I can show trends and argue for one or the other speculation.

In Pharmacy, there is an apparent difference between the departments of Medicinal Chemistry and Pharmacy, where the former demonstrates lots of colour graphics and the latter only a few colour drawings and a map. Again, this would suggest that it is the topic more than the author that generate the use of colour graphics.

In the case of Physics, all five theses have all types of graphics in both b/w and colour, even mixed on one and the same page, and it opens up to speculation wherein the choice between b/w and colour lies. Are they premeditated or haphazard? Is it not expensive to print in colour? An informal source informed me that normally you have folds of maybe 36 pages that go together, so that it would make sense to have all colour illustrations in one such fold instead of distributed everywhere. Still, it seems possible that the printing cost is secondary and that the look of graphic simply depends on the manner in which the graphic was first created.

Illustration 59. Example of a grouped column chart, that is generally not recommended, as the too many columns and the differing colours are difficult to interpret still in original, and not discernable at all in black-and-white. (From Komp Lindgren, P, Dept Cell and Molecular Biology)
Colour is pleasing to the eye and attracts attention. More importantly, colour can be used as a carrier of information. This is generally not recommended in the writers’ technical manuals. Photo copying of printed texts is still widespread among students and teacher (although new usages develop as texts are made available on the internet) and this is normally done in b/w. Another problem is the quality of the printed text that in original might not be high enough to show off the colours as intended. It follows two examples of illustrations where colour carry meaning. Gustavii explains why it is most readers dislike “those grouped column charts that have more than two or three categories in each group.” Look at the illustration, and suppose you look away: what do you remember having seen, without looking back? This type of data might well do better in a table.56

![Illustration 60](image)

*Figure 4.* The major ocean currents, the red arrows illustrate warm water currents and the blue are cold water currents.

*Illustration 60. A map where the feature of colour is a vital carrier of information, so that the meaning of the graphic would be lost on a b/w photo copy. (From Thomas, K, Dept of Engineering Sciences)*

Finally, James Elkins’ experience from the Cork Exhibition (see Introduction section) shows that Biochemistry and Astronomy are image-obsessed, as he calls it, while others think and work through images. Scientists’ choices of colours have specific histories, just as artists’ choices. Some of the more garish productions of astronomical images owe their colour choices to 1960’s hallucinogenic art like Yellow Submarine or tie-dyed T-shirts, and the Eagle Nebula57 owes its colour choices to the history of landscape painting and photography. 58 In these cases you can choose at looking at the connection, or the difference, between art and science.

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56 Gustavii, 2003, p. 21f.
57 Famous cluster of stars.
Forget Faculty Thinking for a While

An alternative perspective of the results is presented in Appendix III, showing a summary of the illustrations ordered by variation of form and frequency – regardless of faculty. This table shows clearly that the departments of the Faculty of Social Sciences stand out as using a variety and number of illustrations that is comparable with those of Medicine & Pharmacy, and Science & Technology, rather than those of the Humanities. Therefore this result gives reason to question how close Social Sciences really are to the Humanities.

Below, the same result is shown in a matrix of two different degrees of varied form and frequency in Illustration 61, including all 49 departments that are a part of this study. The division into four groups is an experiment on my side and an attempt to look with fresh eyes beyond the traditional faculty thinking.

<table>
<thead>
<tr>
<th>More varied</th>
<th>Less varied</th>
</tr>
</thead>
<tbody>
<tr>
<td>High frequency of illustrations</td>
<td>Low frequency of illustrations</td>
</tr>
<tr>
<td>Materials Chemistry, Medical Sciences, Physics, Information Technology, Pharmacy, Cell &amp; Molecular Biology, Engineering Sciences, Surgical Sciences, Evolution, Genomics &amp; Systematics, Earth Sciences, Biochemistry &amp; Organic Chemistry, Business Studies</td>
<td>Physiology &amp; Developmental Biology, Oncology, Radiology and Clinical Immunology, Cultural Anthropology &amp; Ethnology, Genetics &amp; Pathology, Theology, History, Social &amp; Economic Geography, Centre for Clinical Research, English, Government, Neuroscience, Chemistry</td>
</tr>
</tbody>
</table>

Illustration 61. These boxes show a degree of variation and frequency of illustrations, where the order within each square follows Appendix III. Science & Technology departments are marked in green colour, Medicine & Pharmacy are marked in red colour and Humanities & Social Sciences are marked in blue colour. Moreover, Technology, Pharmacy and Social Sciences are bold, to separate them from Science, Medicine and Humanities that are normal. (Graphic by Elisabet Steiner)
The next illustration is a further simplification of the former in that the department names have been replaced with symbols in colour, each representing one of the six domains.

\[
\begin{array}{c|c}
\text{High frequency of illustrations} & \text{Low frequency of illustrations} \\
\hline
\text{More varied} & \\
\begin{array}{c}
\text{Humanities} \\
\text{Social Science} \\
\text{Medicine} \\
\text{Pharmacy} \\
\text{Science} \\
\text{Technology}
\end{array}
\end{array}
\]

\[
\begin{array}{c|c}
\text{Less varied} & \\
\begin{array}{c}
\text{Humanities} \\
\text{Social Science} \\
\text{Medicine} \\
\text{Pharmacy} \\
\text{Science} \\
\text{Technology}
\end{array}
\end{array}
\]

Illustration 62. These boxes show a degree of variation and frequency of illustrations, where the order within each square follow Appendix III. The names of the departments are replaced with symbols for each domain. This way it is easier to see the pattern. (Graphic by Elisabet Steiner)

The Faculty of Social Sciences has therefore turned out to be in the centre of the discussion, and its departments used more often for reference and comparison with other departments. Similar is the case with the Department of Mathematics & Computer Sciences and Medical Biochemistry & Microbiology that are not represented as close to their faculty neighbours as could be expected.

Next I give a short summary of Bazerman’s study and analysis method, followed by an adapted approach to the results of the study at hand.
Bazerman’s Approach to Genre Theory

To Bazerman, writing is a social action. Words have power, and you create worlds of words. Writing helps organise social activities, and writing and reading is a form of social participation. Thus, writing is about sociology. The emergence of certain patterns of written communication give generic qualities not only to texts, but to the way the texts are used in situations, and even to the character of the situation themselves. Bazerman is a socio-linguistic, and does not actually deal with illustrations.

In a study that presented proof for his genre theory, Bazerman made a qualitative analysis of articles, originating in the fields of Biology, Sociology and Literature. The first one is an article from 1953 by Watson and Crick, where they present the DNA double helix model. The second is Robert K. Merton’s article from 1963 about the ambivalence of scientists, and the third is an interpretation of a Wordsworth poem by Hartman in 1964. These texts were examined in the contexts of (i) the object studied, (ii) the literature surrounding the object, (iii) the audience, and (iv) the author. This method builds on James Kinneavy’s communication triangle of language or text mediating among a reality (object) and an encoder (author) and decoder (audience). Bazerman added the dimension of literature, and with this he means the references to the shared knowledge within a community.

Illustration 63. To the left Kinneavy’s classical Communication Triangle from 1961 and to the right Bazerman’s version with the added dimension of “Literature”. (Graphic by Elisabet Steiner.)

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59 Bazerman, 1988, p. 22.  
60 Blog site of changelog@tengrrl.com > search string: communication triangle (May 6, 2008).
What he found was that all three texts were dealing with a phenomenon, an object of study that was also mentioned in the title. This object is either well-known, and thus the symbolic formulations are shared, or, as in the sociology article, the object is not well-known. When it came to the relationship between article and previous literature on the subject, formulations are shared in the DNA article (Biology), which is often the case in the fields of Chemistry and Biology. The literature is codified and embedded in the language, and problematics are discussed in generally accepted modes of argumentation. This means that only the literature relevant for claim is discussed. In the ambivalent scientist article (Sociology), the literature is diverse, unsettled, and open for interpretation, and the essay reconstructs the literature to establish a framework for discussion. The author attempts codification for the future. In the poetry article (Literature), codification is entirely personal, and literature is invoked only in support of the critic’s vision. When it comes to the anticipated audience, it shares an acceptance of much knowledge in the Biology sample. In the Sociology sample, the audience shares no uniform framework of thought or criteria of proof, and must be urged and directed along the lines of the author’s thoughts. In the Literature sample, the audience is above all concerned with private aesthetic experience, and expect to find the comments enriching the experience of reading, and the critic’s comments plausible.

Finally, when it comes to the author’s own self, Watson and Crick play the humble but proud servants of nature. They work for the good of all mankind, but still want some credit for it. Robert Merton is uncertain before his discipline and nature, but through the force of argument he hopes to establish some certainty, and Hartman should be the one to have the least responsibility to establish certainty, but instead he must appear to have greater insight than his readers. Since his contribution cannot be measured in terms of a claim to be judged right or wrong, the quality of his whole sensibility is up for judgment.61

The above was a very dense summary of Bazerman’s extensive analysis of the three different texts, but it shows in what way his method is innovative – above all through his extension of the communication model to include the literature of a field – and how he can build on the results to explain his genre and activity theory.

The diversity of the knowledge-producing activity in these three texts suggests how important the form of knowledge is. Getting the words – or the illustrations – right is an own enterprise, and getting it right depends not only on an individual’s choice, but dictated by the discipline, in its communally developed resources and expectations, in its literature. The illustrations, and the perception of them – thus arise out of the activities, procedures, and relationships within the community.

61 Bazerman, 1988, p. 47-48
The solutions of how to use graphics is therefore unique within each respective discipline.

Visual Approach to Genre Theory

In this study, I do not use the same method as Bazerman. I have not looked at one text sample from each discipline, and analyzed the background to each illustration, but this would be a possible extension to this study. In an attempt to copy Bazerman’s method of analyzing study results, I here summarize three characteristics that were commented on at some length earlier in this chapter. The three contexts I choose are (i) Pagination, (ii) Electronic Availability, and (iii) Publishing Tradition, comparing the results from the six domains of Humanities, Social Sciences, Medicine, Pharmacy, Science and Technology.

![Diagram](image)

Illustration 64. Adaptation of Kinnevy’s communication triangle, where the signal is changed from Language to Illustration, analysed in the contexts of Pagination, Electronic Availability, and Publishing Tradition. (Graphic by Elisabet Steiner.)

Pagination

I noticed early in the study that there were strict rules within Natural Sciences about the parts that build a thesis, whereas there seemed to be no rules within the Humanities and Social Sciences. This turns out to be only partly true, as some fields in the Social Sciences show a trend to lean on similar rules as the Natural Sciences, especially Psychology that has a hundred year old tradition of writing rules (the APA Style). On the other hand, authors belonging to a Natural Science department were seen to practice the full pagination without the division in papers. This might very well be a consequence of the interdisciplinary work achieved within the university faculties and departments.

The most obvious common trait of the Humanities theses is that they are uniformly paginated, with a wide range of pages, from 145 to 568. The only exception to the rule is a thesis from the Dept of Cultural Anthropology and Ethnology (Faculty of Arts).

Social Sciences are divided: a uniform pagination, ranging from 121 to 421 pages, is presented in 17 theses, whereas 13 show a different layout, including a
summary of on average 70 pages, plus 3 to 4 essays, mostly with separate paginations, as otherwise seen within the Natural Sciences. Pharmacy and Medicine show strict consistency with a main part combined with papers. The same is the case with Science & Technology, were it not for the Faculty of Mathematics & Computer Science that presents two disagreements to the rule.

Electronic Availability

That a thesis is available in full text online has in recent years become a most important feature that is mentioned in several places: in the abstract, in the bibliographic record, and first thing in the printed text itself. In this context, I noticed the same pattern, that Humanities and Social Sciences, in that order, were less current in full text online as the Natural Sciences.

The Humanities count 25 theses, whereof less than 10 percent are available online. The Faculty of Social Sciences counts 30 theses, whereof 60 percent are available online. Medicine counts 37 theses, whereof 92 percent are available online. Pharmacy counts 9 texts, whereof 100 percent is available online. Science and Technology together count 46 theses, whereof all but one, i.e. almost 100 percent are available online. Mathematics & Computer Science is a faculty that occasionally disagrees with the dictated rules, both when it comes to pagination, online availability and publishing tradition.

In the future students will expect to have access to research material and also to easily copy and reuse the material for learning purposes online. As already mentioned in the introductory chapter (subchapter Primary Sources) about 80 percent of the investigated texts were available as pdf-file online 2007, to be compared to only 25 percent in the year 2000. The reason why not 100 percent of the theses are already available is not that some documents are too heavy, as is exemplified by two theses from the Dept of Education, that are published online although the texts of 300 to 400 pages including illustrations need 20MB of space. Instead it seems that there is a fee of about SEK 4000 involved in the online publishing process, a fee that not all faculties are obliged to donate. This means the fee occasionally is left to the author, who perhaps is already struggling with stretched finances, which seems to explain why some theses never turn up in full text online. Wennerström from Uppsala University Library comments that it has been noticed by people working with the open source project that the SEK 4000 fee is contra-productive, and seeing that the work of writing an abstract and finding the key words is executed by the authors, there seems to be a discussion going on about changing these procedures in favour of the open source movement.

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62 Wennerström, Clifton, electronic correspondence dated April 1, 2008 (see References, Primary Sources).
The Uppsala University Publishing Organ

Acta Universitatis Upsaliensis (AUU) is the publishing organ of the Uppsala University. This institution carries out one of the activities that bring value to the genre through their application of specific faculty symbols at the beginning of their publications. The theses of Humanities & Social Sciences are published to only 50 percent by AUU, whereas Medicine & Pharmacy Science & Technology are published to 100 percent by AUU.

In Natural Sciences, each of the faculties have their own specific symbols, logos that helps the reader immediately recognise the discipline, which brings a reinforced impression of an established (and therefore high value?) structure. Humanities and a greater part of Social Sciences, such as Government, Business Studies, and Education share the generic symbol of the university, and hence do not have a logo to be recognised by. However, again, some Social Sciences departments such as Psychology and Information Science sport their own logo as well.

Illustration 65. From left to right the symbols from the Faculties of Technology, Pharmacy, Social Sciences (when represented by Psychology and Information Science), and Humanities (generic symbol). Excuses are made for the bad quality; watermark graphics are not always legible in print.

Activities Building the Genre

There are a number of activities or actors that together build a genre as described by Bazerman. The author and the reader, together with other actors, all help maintaining and changing a genre. Without any claim of covering the subject fully, I will further discuss writers’s manuals, computer graphic tools, and the role of librarians.

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61 Bazerman, 1988, passim.
Writers’s Manuals

To get an overview of how illustrations are taught to academics, I looked at 70 manuals, 43 in English and 27 in German, gathered in the library of the Swiss Federal Institute of Technology in Zurich, and this is what I found:

Half of the books (35) contained little worth remembering about visualising scientific knowledge. Two bore proof of their own genre, in the way that they did not only deal with poetic composition style, but were published in hard covers, protesting for scientific purposes and unusual fonts and page design. Two dealt solely with library resources and citations, and one with the problem of plagiarism through cut-and-paste in Google. One book was about understanding statistics, but surprisingly did not translate this into a graphic language at all. In three books the importance of graphics were stressed, but not further mentioned (!). The remaining 26 covered the subject of illustrations on a few lines, maximum half a page – or not at all.

In 6 books advice was given about illustrations only in the context of giving a talk, and in the use of overhead transparencies and power point slides.

In 27 books well-structured and useful advice about tables, charts and other graphics was offered in one or even two chapters. For example the Chicago Manual of Style, the Chicago Guide to Communicating Science, and the Oxford Style Manual are literally not to be overlooked (heavy-weights). Another 2 books even went a step further in that advice was given to the contemplation of statistics and how to translate the results into graphics with the help of flow chart, mind-mapping, and network techniques.

This means that out of 70 manuals that promised to instruct on how to write a master paper or a doctoral thesis, only 29 made useful observations on the matter of illustrating scientific knowledge. These latter originate in a natural science or technology faculty, such as Biology, Engineering or Medicine, whereas the authors generally assume in their introduction chapter that the know-how displayed is universally useful for all disciplines.

In order to see what kind of books about visualisation written by – or for – humanists were available, I chose to look more closely at The Walford Guide, alleged to be a leading biographical guide to reference resources, the newest edition of which, The New Walford, 64 received a lot of praise. Volume 1 which covers Science, Technology and Medicine was published in 2005, and Volume 2 which covers The Social Sciences was published in December 2007. Starting with Volume 1, I queried the references to the word “visualisation”, and found 7 items that represented either books or web sites. Moving on to Volume 2, however, the same word gave no results. I tried other terms such as “illustration” or “image”,

but there was not one reference to be found. I did find a reference though, to Edward Tufte, the renown author of a classic text in the genre of writers’s manuals: *The Visual Display of Quantitative Information*. The former professor at Yale University taught courses in statistical evidence, information design and interface design.65 *The New Walford* informs that Amazon.com chose the book as one of its best 100 books of the 20th century. Still, the impression remains that Tufte constitutes an exception to the rule and that visualisation is just not an issue within Humanities and Social Sciences.

*The Department of ALM’s Writing Manual*

The same message is conveyed in the writers’s manual created by the Department of Archive, Library and Museum (ALM) in Uppsala, i.e. domain of Humanities, for their thesis-writing students. In Rydebeck’s guide, there is a lack of details on image handling, as if it were of minor importance.66 Whereas there are a lot of pages devoted to type faces and size, disposition, and the different text functions such as footnotes, citations and bibliography, there is one chapter on one page that concern graphics, titled (translated from Swedish) "Tables and Diagrams". Rydebeck admits to dealing very superficially with this subject, mentioning that (i) table and figures should be numbered and, if many, listed separately, (ii) what a table heading and source reference should look like, and (iii) the rounding down of figures and when to use percent. Instead of going into more detail, Rydebeck refers to the reference list at the end. In addition, in a section that outlines the text layout, Rydebeck includes a short paragraph with the headline “Tables and other Figures and Pictures”, where she states that it is very difficult to create templates that would fit all students’ need of tables and diagrams, and therefore the students "would have to deal with it yourselves."67

*The APA Style*

The American Psychological Association has established a style – the APA style – that is used in all of the books and journals that it publishes. This style is also translated into Swedish and well established in Sweden. Many others working in the social and behavioural sciences have adopted this style as their standard as well.68 APA's style rules and guidelines are set out in a reference book called *The Publication Manual of the American Psychological Association*. It includes for example standardized subheadings so that each report conveys the same sort of information in the same order. In their article from 1995, Madigan et al. argue that APA style involves more than a set of explicit guidelines for presenting

68 Web site of APA Style.org (May 2, 2008).
information, but also incorporates not self-reflected practices of fundamental attitudes and values of psychologists. Therefore they compared a set of empirical reports published in journals in Psychology as well as History and Literary Criticism in order to identify distinctive characteristics of APA style from an epistemological perspective. What they found was that “the extensive use of discursive footnotes in Literary Criticism and History has the effect of establishing a second, parallel text that the author can use to rhetorical advantage”.

On the other hand, by announcing the next major topic with the help of subheadings, psychologists do not need to include a transitional passage to connect major sections. Instead, these authors need to be skilled on two levels: not only should they master the general prescribed approach favoured by the discipline, but also develop very subtle stylistic nuances that separate novice and expert writers.

The article only deals with language and citation style and does not mention graphics. However, the article – written in APA style - includes three black-and-white photos of the three authors as well as five column charts and a table in a conforming style, reminding of the table with thick green separating lines, as shown in Illustration 12. Nevertheless, the use of illustrations in Psychology as seen in this study does not mirror a restricted look. The explanation given by Madigan et al. is that as APA style is adapted to other contexts than empirical reports, for example, theses or term papers, authors become more free to express their own stylistic preferences.

Computer Graphic Tools

The main concern of Information Technology, a field within Mathematics & Computer Science, is the development of computer technology in the service of mankind (as mentioned in the introductory chapter in the case of the Centre for Image Analysis in Uppsala). Some of the new techniques are directly applicable for, e.g., better diagnosing illnesses, and they automatically generate effective computer graphics. Thus, students within Medicine, Pharmacy, Science and Technology come in contact with special computer software during their education. To an extent these are also made available to the interested layman, as in ”Make a micrograph”, a flash-driven application offered by the Children’s Hospital in Boston on their web site. Examples from the field of Biochemistry would be software such as the Vascular Modeling Toolkit, BiQ-Analyzer, Vector

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70 Madigan et al., 1995, p. 434.
71 Web site of Children’s Hospital in Boston > Research > Featured Research > Interactive Features > Make a Micrograph (April 28, 2008).
NTI, GSEA-P (a desktop application for Gene Set Enrichment Analysis), etc. There are also several open source download sites, such as the Free Downloads Center, that again is oriented towards the natural sciences, and similar sites are not as easily found directed to Humanities and Social Sciences.

Elkins found in his exhibition at the Cork University that the ways of creating and interpret images fall into two groups: (i) disciplines whose image-making practices are technical, and (ii) those that appear not to be. He explains that it is also a fact that scientific examination requires technical knowledge.

An example of the use of visualisation as a tool to develop methodology within Social Sciences was presented in a case study on Time Geography. The research was carried out as part of an interdisciplinary project called Norrköping Visualization and Interaction Studio (NVIS). Joanson asks why the new visualising techniques leading to new scientific methods seem to have passed unnoticed by Humanities and Social Sciences. Time Geography means to study daily life in a space-time context and has a long tradition of visualisation practice, i.e. scientists used to lean on artists to try and visualise the complex data acquired from field studies. Nowadays they lean on computer experts. Although the computer age had brought new tools of visualisation, Joanson found that there was “a lack of social scientists harvesting them”. The research data is very complex and therefore the visualisation of them is needed to develop new research methods, as well as to show the results. Joanson comes to the conclusion that increased cooperation between social scientists and computer programming experts is desirable in order to make this happen.

There is also the field of Information Science (not to be confused with Information Technology that was mentioned above) within Social Sciences, where research is done on new statistical methods, on media communication, user behaviour (of, e.g., eye movements across a computer screen), and new data base designs. The department web site in Uppsala does however not offer information on research on graphics or computer graphic tools. The Department of Information Science takes is part of this study with one thesis (graphic examples in the Results section) that deals with human vision, and “how to best convey quantitative information 3D visualisations” – from a cognitive viewpoint.

One example of a commercial software web site which offers software for statistical data analysis is Scientific Software International (SSI).

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72 Web site of Biowaredb.org > Interesting Software (May 2, 2008)
73 Web site of Free Downloads Center > Search query: Scientific (May 2, 2008)
76 Forsell, Camilla, Dept of Information Science (see References, Primary Sources).
To summarise, computer graphic tools are used both to do research as well as report it, and to bring the topic closer to the wider public. The table data from which a chart is made can be quite basic or very complicated, and it takes an experienced reader to understand which is which. Take Microsoft Excel for example, which has been available as standard software in personal computers for many years, and which can be used by novices and experts alike. This is a tool that is available to all scientists in all departments. The inexperienced user enters data into a table, which is translated into a chart by the machine if wanted, whereas the skilled user writes macros and/or custom functions. It is interesting to consider how this tool can be used as much for analysing as reporting results, and that the scientist develops a mind about the research by entering data in various ways until an interesting pattern shows up. This is comparable to fetching a pen and paper to outline an idea for oneself or communicate it to others, when words are not enough.

The Role of Librarians

Librarians are increasingly involved in teaching writing and research, and therefore it is in their interest to effectively share knowledge of domains. One example of this is a guide created by a group of reference librarians at the University of Denver. On one hand they each wrote a chapter on their own special subject, on the other they were all involved in the editing of all chapters. I especially mention this, because the result is impressive, in that the book presents ten chapters that deal with research in the Humanities, Music, History, Business, Engineering, etc., listing all kinds of resources that of course differ depending on subject; however, what is similar is the absence of any mentioning of illustrations. As we have seen from the results at hand, it is not like illustrations are absent (except possibly for Humanities), but librarians do simply not consider them.78

When it comes to the Uppsala University Library routines, the theses are treated as important reports alongside books and journals, which can be inferred from the user interface of the online catalogue:

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78 Keeran, Peggy et al., 2007, Research within the Disciplines. Foundations for Reference and Library Instruction, passim.
However, although they vary much in appearance, this is not mirrored in the bibliographic details. This is because the theses are not catalogued by librarians at the university, but by the authors themselves on a form that they can download and fill in. This means, that the theses are catalogued at the simplest level (level 1 in accordance with AACR2 1.0D1), and that the presence of illustrations (or attachment such as a CD or map) is not taken into account. However, when the items are imported into the national library systems (Libris), the bibliographic reference “ill.” (level 2) or the reference of tables or maps (level 3) is added by cataloguing experts.79 This means that there would be a way to pay attention to the form and frequency of illustration use by adding such features to the form that is filled in by the authors themselves.

### Final Comments

Why do some scholars not use illustrations as much as others? One reason is of course that they live and act the genre theory that I have used in the discussion of my study results. Being a humanist or social scientist thus means that you are blind to the characteristics of an illustration in its original form, because you are involuntarily imitating the people surrounding you in your research field, and used to reasoning around concepts, even picturing them in your mind, but not handle as material images. However, the dictation of genre does not cover the whole truth.

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79 Wennerström, Clifton, electronic correspondence dated April 1, 2008 (see References, Primary Sources).
Another explanation lies in field of education, and the way different people acquire knowledge. VARK is a well-known concept for pedagogues, and stands for various ways to learn, i.e. visual, aural, read & write, and kinaesthetic. Also, Howard Gardner’s theory of the multiple intelligences turns against the traditional view of intelligence and learning that gave rise to Intelligence Quote tests, a practice that Gardner rejects. Instead, Gardner uses a range of criteria to prove the existence of at least seven types of intelligences, which all people have, but in different combination of these. The intelligences are realised only through the surrounding cultural possibilities; imagine Beethoven without the musical culture of his time. Examples of these intelligences are naturalist, logical-mathematical, and visual-spatial intelligence. Thus the important insight is that people have many and various potentials and learn in different ways. Who turns humanist and who turns natural scientist? The education system in combination with the inherent potential has influence on this.

As a consequence, it is possible that some scholars do not use illustrations because they lack the know-how to copy them without losing quality, or reproduce them using computer software. In school, we generally learn for many years and on increasingly difficult levels to read and write and understand the meaning of language, but we do not generally learn the language of images, how to read them – and to produce them – in a wide range of media.

A third reason, if seemingly secondary, might be the difficult question of copyright. The written language is extremely flexible, and as long as you summarize the thoughts of a colleague, it is not a breach of copyright. With illustrations, it is not that straightforward that you can copy them and name the creator. It says in most laws all over the world that a consent from the creator is needed. However, there is often some room for exception, as is the case with the US “fair use doctrine” (in Swedish “inskränkningar i upphovsrätten”). Among other things, “quotation of excerpts in a review or criticism for purposes of illustration or comment; quotation of short passages in a scholarly or technical work, for illustration or clarification of the author’s observations” are regarded as fair use. The American copyright law also states that:

Copyright protects the particular way an author has expressed himself; it does not extend to any ideas, systems, or factual information conveyed in the work. The safest course is always to get permission from the copyright owner before using copyrighted material. (- - -) When it is impracticable to obtain permission, use of copyrighted material should be avoided unless the doctrine of “fair use” would clearly apply to the situation.

81 Web site of Sveriges Riksdag > Search string: inskränkningar i upphovsrätten > Svensk författningssamling 1960:729 (April 7, 2008)
82 Web site of United States Copyright Office > Search string: Fair use (April 7, 2008)
83 Web site of United States Copyright Office > Search string: Fair use (April 7, 2008)
It is against this background that I included the occasional copyrighted illustration in this paper.

Finally, there is the question of evidence presentation as both a moral and intellectual act. The use of images in combination with text raise questions as to image quality and the instructive worth of an image as carrier of information. Humanists and to some social scientists distrust the credibility of illustrations of tradition, and with good reason, as can be seen from the example of Darwin’s Photographs or the computer graphics shown in Illustration 56. There is an unwritten contract between author and reader that stipulates that the reported data are credible. The practice of writing should derive from universal principles of analytical thinking and not from local customs, intellectual fashions, consumer convenience, marketing, and such. \(^{84}\)

In his book from the Cork Exhibition, Elkins devotes a whole chapter to abuses, which he calls the rather high percentage of images that are not used to support the science. The reason they exist is because they serve some kind of political ends, he explains. \(^{85}\) The “abuses” that he found were, for example, habitual, compulsive and useless visualisation.

With habitual visualisation he means when a “normal” image of cheddar cheese that is good enough for research purposes is suddenly turned into a spectacular blue-and-white image aimed for advertising. It is often the case, that the images used for posters at conferences or covers of scientific journals are more aesthetically pleasing than those aimed for publicity inside and outside the university. This would explain the partly very low quality (as in low legibility) of papers that were copied from scientific journals where they were once published, and also suggest that the publishing of the theses is only a formality because nobody will read it in that form anyway. With compulsive visualisation Elkins intends a situation where the author insists on visualising even when there is no need to, and, finally, useless visualisation includes all images presented for effect, graphics that “cannot be used to calculate because that have nothing quantitative in them”. I do not totally agree with Elkins interpretation of non-scientific images, but it is one way to look at it, and might explain the motives of those scholars that resist the use of illustrations.


Future Outlooks

This study is only a modest beginning in trying to map the use of illustrations in scientific communication, more precisely doctoral theses. A possible continuation of the study would be to map the computer graphic tools actually available in the departments, and also to make qualitative interviews and surveys to find out more about the existing knowledge of creating computer graphics.

I believe that a better know-how of data bases (containing table data that are the foundation of other illustrations) and graphic tools would have enabled me to create better graphics in order to support my arguments. The question more to the point is: Would the conclusions change with better know-how of data base and graphic tools?

If that is the case, library and information specialists would not only need to acquire the know-how to read graphics, but also the know-how to create them, and thereby heighten the awareness of the technical as well as moral complications involved.
Conclusions

I have looked at the use of illustrations in doctoral theses from the viewpoint of Bazerman’s Activity and Genre Theory and found proof of such genres stipulating the use of graphics in each discipline, but at the same time found exceptions to the rule that point towards the influence of the author’s personal learning preferences.

When it comes to frequency Humanities offer the least illustrations and Medicine the most. When it comes to variation, again, Humanities offer the least illustrations whereas Medicine, Science, and Technology offer the most. This result was somewhat expected and therefore not spectacular.

However, there were some further tendencies worth noting. Social Sciences are at odds, in that the use of illustrations of approximately half of the departments is consistent with those of Medicine & Pharmacy and Science & Technology, and the other half is consistent with Humanities. Similarly, the Department of Mathematics & Computer Science stands out in that it does not follow the general Technology genre, but show a trend that would position it in the area between Humanities and Social Sciences.

Natural scientists set out to explain the world, but do not normally reflect on themselves and their work; that lot falls to humanists and social scientists. Is it then the topic that governs the use of illustrations, and is it so that talking about science does not need illustrations in the same extent as doing science? Yes, I believe so. It is a fact that while natural scientists have a long tradition of using illustrations to show the natural world, humanists insist on interpreting them into language, to talk about them and describe them - without showing them.

What governs this behaviour is influenced not only by institutional structures and their publishing and editing traditions and computer tools at hand, but by the individual author’s learning preferences and acquired level of know-how.

Moreover, not only did I find that humanists used very few illustrations, but they do not reflect on this fact, and self-reflection was my motivation for doing this study.
References

Primary sources

164 dissertations, published at the University of Uppsala in 2007. A detailed list is available on request (see below).

Electronic correspondence with Clifton Wennerström, Uppsala University Library, and Ewert Bengtson, Centre for Image Analysis, printed copies of which are available on request. Please write to: elisabet.steiner@gmx.ch, or Elisabet Steiner, Austrasse 27, 8134 Adliswil, Switzerland.

Secondary sources


**Web Sites**

Of Tertiary Sources, Organisations, Authorities, and Private People

*The following web links were last checked on May 6, 2008.*

*About.com.* URL: http://chemistry.about.com/od/periodictables.


*Biowaredb.org.* URL: http://biowaredb.org/site.

*Changelog@tengrrl.com.* URL: http://www.tengrrl.com/vita/veb.html.

*Children’s Hospital Boston.* URL: http://www.childrenshospital.org.


*Oregon Graduate Institute of Science and Technology.* URL: http://cselu.cse.ogi.edu.


*Sveriges Riksdag (Swedish Parliament).* URL: http://www.riksdagen.se.


*Uppsala University.* URL: http://www.uu.se/en.

List of Illustrations, Tables and Appendices

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(Excluding all alternative field names also kept in the catalogue - although not in use.)

Biology
- Biology Education Centre
- Klubban Biological Station
- Dept of Bioorganic Chemistry
- Dept of Cell and Molecular Biology
  - Immunology
  - Microbiology
  - Molecular Biophysics
  - Molecular Biology
  - Molecular Cellbiology
  - Structural Biology
- Dept of Ecology and Evolution
  - Conservation Biology and Genetic
    - Dept of Animal Ecology
  - Erken Laboratory
  - Limnology
  - Plant Ecology
  - Population Biology
- Ecological Research Station, Ölands Skogab
- The Linnaeus Centre for Bioinformatics

Chemistry
- Dept of Biochemistry and Organic Chemistry
  - Avdelningen för biokemi
  - Avdelningen för organisk kem
- Dept of Materials Chemistry
  - Dept of Photo Chemistry and Molecular Science
  - Dept of Physical and Analytical Chemistry
    - Analytical Chemistry
    - Physical Chemistry
    - Quantum Chemistry
    - Surface Biotechnology

Earth Sciences
- Dept of Earth Sciences
  - Air and Water Science
  - Construction Engineering
  - Environment and Landscape Dynamics
  - Geophysics
  - Palaeontology group
  - Quaternary Ecology group
  - Solid Earth Geology

Faculty of Arts
- Centre for Gender Research
- Centre for Multiethnic Research
- Dept of Archaeology and Ancient History
  - African and Comparative Archaeology
  - Archaeology
  - Classical Archaeology and Ancient History
  - Egyptology
- Dept of Art History
- Dept of ALM
- Dept of Cultural Anthropology and Ethnology
  - Cultural Anthropology
  - Ethnology
  - Forum for School
- Dept of History
- Dept of History of Science and Ideas
  - History of Science
- Dept of Literature
  - Rhetoric
  - Sociology of Literature
- Dept of Musicology
- Dept of Philosophy
  - Aesthetics
  - Ethics and Social Philosophy
  - Logic and Metaphysics

Faculty of Educational Sciences
- Dept of Curriculum Studies
- Dept of Studies in Education, Culture and Media

Faculty of Languages
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Dept of Classical Philology
Dept of English
   Celtic Section
Dept of Linguistics and Philology
   Asian and African Languages and Culture
   Classical Philology
   Linguistics
Dept of Modern Language
   Finno-Ugric Languages
   German
   Romance Languages
   Slavic Languages
Dept of Scandinavian Language
   Advanced Studies in Modern Swedish
   Scandinavian Onomastics

Faculty of Law
   Dept of Law
   Huvudadministration inkl. Ekonomi- och personaladministration
   Miljörätt
   Rätts historia och allmän rättslära

Faculty of Medicine
   Dept of Genetics and Pathology
   Dept of Medical Biochemistry and Microbiology
   Dept of Medical Cell Biology
   Integrativ Fysiologi
   Dept of Medical Science
   Biomedical Informatics and Engineering
   Clinical Bacteriology
   Clinical Chemistry
   Clinical Pharmacology
   Clinical Physiology
   Clinical Virology
   Dermatology and Venereology
   Infectious Diseases
   Internal Medicine
   Molecular Medicine
   Nutrition
   Occupational and Environmental Medicine
   Respiratory Medicine and Allergology
   Dept of Neuroscience
   Child and Adolescent Psychiatry
   Clinical Neurophysiology
   Comparative Medicine
   Developmental Genetics
   Developmental Neuroscience
   Neuroanatomy
   Neurobiology
   Neurology
   Neurosurgery
   Ophthalmology
   Pharmacology
   Physiology
   Physiotherapy
   Psychiatry, Ulleråker, University Hospital
   Psychiatry, University Hospital
   Rehabilitation Medicine
   Dept of Oncology, Radiology and Clinical Immunology
   Avdelningen för sjukhusfysik
   Biomedical Radiation Science
   Clinical Immunology
   Oncology
   Radiology
   Comparative Medicine
   Dept of Public Health and Caring Science
   Biomedical Ethics
   Caring Sciences
   Centrum för miljörelaterad ohälsa och stress (CEOS)
   Clinical Nutrition and Metabolism
   Family Medicine and Clinical Epidemiology
   Geriatrics
   Health Services Research
   Nordic Centre for Classifications in Health Care (WHO-FIC)
Social Medicine
Dept of Surgical Sciences
  Anaesthesiology and Intensive Care
  Forensic Medicine
  Hand Surgery
  Oral and Maxillofacial Surgery
  Orthopaedics
  Otolaryngology and Head and Neck Surgery
  Paediatric Surgery
  Plastic Surgery
  Specialist Education of Nurses
  Surgery
  Thoracic Surgery
  Transplantation Surgery
  Urology
Dept of Women's and Children's Health
  International Maternal and Child Health (IMCI)
  Obstetrics and Gynaecology
  Pediatrics

Faculty of Pharmacy
Dept of Medicinal Chemistry
  Analytical Pharmaceutical Chemistry
  Division of Pharmacognosy
  Organic Pharmaceutical Chemistry
Dept of Pharmaceutical Biosciences
  Biological Research on Drug Dependence
  Division of Pharmacokinetics and Drug Therapy
  Pharmaceutical Biochemistry
  Pharmaceutical Microbiology
  Pharmaceutical Pharmacology
  Toxicology
Dept of Pharmacy

Faculty of Science and Technology
Dept of Evolution, Genomics and Systematics
  Dept of Physiological Botany
  Evolutionary Biology
  Evolutionary Functional Genomics
  Molecular Evolution
  Systematic Botany
  Systematic Zoology

Faculty of Social Sciences
Dept of Business Studies
Dept of Commercial Law
Dept of Domestic Sciences
Dept of Economics
Dept of Economic History
Dept of Education
Dept of Euroasian Studies
Dept of Government
  Development Studies
Dept of Information Science
  Computer Science
  Human-Computer Interaction
  Media and Communication
  Statistics
Dept of Peace and Conflict Research
  Conflict Resolution in Africa
  South East Asia Programme
  States in Armed Conflict
Dept of Psychology
Dept of Social and Economic Geography
Dept of Sociology

Faculty of Theology
Dept of Theology
  Church and Mission Studies
  Ethics and Philosophy of Religion
  History of Religions
  New Testament Exegesis
  Old and New Testament Exegesis
  Old Testament Exegesis
  Psychology of Religion
  Sociology of Religion

Visual Scientific Communication. The Use of Graphics... 3 (4)  Elisabet Steiner, 2008
Studies in Faith and Ideologie:

Forskningsprogram som stöds av stiftelser
Angström Solar Center

För teknisk-naturvetenskapliga fakulteten gemensamma enheter
Tandem Laboratoriet
The Studsvik Neutron Research Laboratory

Interfaculty Units
Centre for Clinical Research
Centre for Environment and Development Studie
Centre for Image Analysis
Centrum för klinisk forskning, Gävlebon
Real Estate Research Institut
The Svedberg Laboratoriet
The Swedish Collegium for Advanced Study in the Social Sciences (SCASSS)

Mathematics and Computer Science
Dept of Information Technology
  Dept of Computer System
  Dept of Human-Computer Interaction
  Division of Computing Science
  Division of Scientific Computing
  Division of Systems and Control
Dept of Mathematics
  Mathematical Statistics
  Mathematics

Physics
  Tekniskt och naturvetenskapligt baså
Dept of Physics and Astronomy
  Centre for Dynamical Processes and Structure Formatio
  Division of Applied Nuclear Physics
  Division of Astronomy and Space Physics
  Division of Nuclear and Particle Physics
  Division of Theoretical Physics
  Swedish Institute of Space Physics, Uppsala Division
Dept of Physics and Materials Science
  Atomic and molecular physics
  Condensed Matter Theor
  ESCA-LASER-laboratoriet
  Materials Physics
  Physics Didactics
  Surface and Interface Science Division
  Surface Physics
  Theoretical Magnetism
  Undertavning

Technology
  Dept of Engineering Sciences
    Accelerator mass spectrometry group
    Analytical Material Physics
    Angström Space Technology Centre (ASTC
    Division for Electricity and Lightning Research
    Ion Physics
    Materials Science
    Microstructure Laboratory
    Signals and Systems Group
    Solid Mechanics
    Solid State Electronics
    Solid State Physics

Units outside the University
Institute for Housing and Urban Research
Ludwig Institute for Cancer Research
Nordic Africa Institute
Office of Labour Market Policy Evaluation
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<th>Department of</th>
<th>Tables</th>
<th>Text boxes</th>
<th>Photos</th>
<th>Drawings</th>
<th>Charts</th>
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<td>Some</td>
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Visual Scientific Communication. The Use of Graphics ... 2 (2) Elisabet Steiner, 2008
APPENDIX III. Graphics ordered with the highest frequency at the top.

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