



Aesthetics and preferences of web pages

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Abstract. The first impressions of web pages presented to users was investigated by using 13 different web pages, three types of scales and 18 participants. Multidimensional analysis of similarity and preference judgements found four important dimensions: beauty, mostly illustrations versus mostly text, overview and structure. Category scales indicated the existence of two factors related to formal aspects and to appeal of the objects, respectively. The best predictor for the overall judgement of the category scales was beauty. Property vector fitting of the multidimensional solutions with the category scales further indicated the importance of beauty for the preference space. Aspects of usability, product design and aesthetics are discussed.

1. Introduction

When people use the internet today, they are almost always met by a web page. This page should tell the user of its content and it should provide further information on how to proceed. Many users look up a certain web page for a particular piece of information, but many users also 'surf' around without any particular aim for their search. For the latter category of users, there is much competition for the attention and he or she may easily move to another site if the site does not prove to be satisfactory. The reasons for moving away from the site could be technical, e.g. if the loading is very slow, content-related, e.g. the site does not provide what is expected and form-related, e.g. the first home page gives a bad impression to the user. It is important that the first impression of a novel site be appealing to the user. Sometimes a distinction is made between intranets and extranets, i.e. nets that are meant to be used within an organization for internal information and nets intended for outside communication. Cuomo *et al.* (1998) have written about problems of using an intranet. This investigation is focused on some aspects of extranets.

Much research effort has been aimed at aspects of usability, but other aspects, such as aesthetics or

sensitivity are becoming more important for products. Jordan (1998) argues that usable products are not equivalent with pleasurable products. He found for a number of products, that those experienced as pleasurable were used more often than those that were not pleasurable. The amount of pleasure was also likely to have an effect on future product choices. Nielsen (1997) sees the transition from performance-related to more pleasure-fulfilling activities to necessitate the study of what pleases and attracts users, and uses the term 'seductive user interfaces' for this endeavour.

Berlyne (1971) explained aesthetics in psychological terms by relating a number of so-called collative variables, such as complexity, novelty and wholeness to the Wundt curve determined by the arousal of the reticular system. Berlyne introduced the term 'collative variable' as a part of his theory. The variables and theory that Berlyne developed has generated much research, but this approach was criticized by, for example, Martindale *et al.* (1990). They rejected the arousal component in Berlyne's theory and stressed the importance of other variables, semantics being one of the foremost of these. Berlyne's integration of information theory with behaviourist concepts was fruitful for experimental aesthetics, but was also artificial, since it avoided emotion and content (Cupchik and Heinrichs 1981). Crozier (1994), in discussing design of products and their appeal, argued that Berlyne's approach was too strongly focused on aspects of form of objects. One needs also to understand two other aspects, viz. how people understand an object and how they use it, i.e. meaning and function. In product design of consumer products, sensuality was studied in order to enhance the pleasure of personal pagers for a group of women users (Hofmeester *et al.* 1996). Crozier and Greenhalgh (1992) have argued for a theory based on empathy between object, perceiver and artist. Their theory sees aesthetics as a personal relationship.

A new approach to explain aesthetics is to put it in the framework of evolutionary psychology, (Kogan 1994, 1997). The appreciation of beauty is seen as hard-wired into our genetic set-up and the aesthetic feeling fulfils an adaptive, biological function.

Today a web page is an important part of the image of a company or organization. The design profession was active early in forming a corporate design and making the product identity (Heskett 1980). Many Scandinavian firms did, for example, establish an image of quality in consumer goods, such as glass, by their design. For a company today, the first impression that its home page gives will also, we believe, be important for the appeal and attitude towards that company.

The use of a web page is determined by a number of factors: the information provided, the usability of the site and the impression given to the user. The feeling that a person has towards the site may vary from time to time and also within a session. However, a new user's first or second impression of the site will most likely be important in making the user stay. This study concentrates on this aspect of use, i.e. the first visual impression that a person gets of a web site. We believe that more formal variables such as those named collative, and others relating, for example, to semantics, are important factors for determining the appeal that web pages may have on users. In this study, the user was studied when he or she was not permitted to move along the site itself.

One useful method for investigating people's perceptions of computer and telecommunication products is by the use of multidimensional scaling (MDS) (see, for example, Batt and Katz 1998). MDS makes it possible to understand underlying psychological structures, and not only surface behaviour, which is visible to an observer. For example, the traditional market research approaches that rely only on overt characteristics such as attitudes are weak predictors of consumer behaviour, while MDS is more effective (Batt and Katz 1998). The perceived value of products has also been an object for modelling by MDS by, for example, Sinha and deSarbo (1998). They argued that this enables us to infer perceived customer value of commercial products from data without specifying these a priori. The appeal of a web page is, we propose, an instance of perceived value. MDS was used by Berlyne and his group in studying experimental aesthetics as one of their approaches, since they might discover attributes that were predominant in a person's perception of the stimulus material with this method (Hare 1981). Experimental aesthetics is seen as a method to understand aesthetics with the use of experimental methods as compared to the more

traditional methods that often use qualitative and interpretative methods.

The purposes of this study were:

- to investigate how web pages are experienced aesthetically by a group of users;
- which kind of web pages they prefer and how this preference may be described;
- what subjective factors determine the overall impression of a web page?

2. Method

2.1. Participants

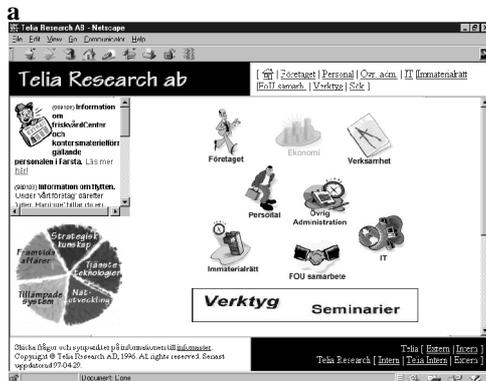
Eighteen persons, seven men and 11 women, between the ages of 21 to 43 with a mean of 30 years, participated in the experiment. They were all psychology students and each had had some previous experience in Internet use. Their vision was measured with a Snellen test at 4 m and was considered normal (either corrected or non-corrected) for 16 of them. One person had defective sight in one eye (0.13) and another person had defective sight in both eyes (0.5 and 0.4). The MDS solutions when including these people were no different from those where they were excluded. These two people were therefore included in the study, since it was judged that their deficiencies would not affect the purposes of the experiment.

2.2. Stimuli

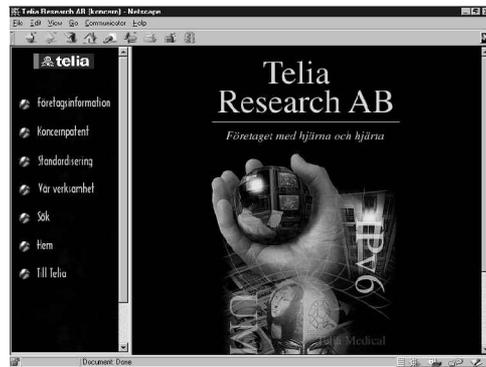
As stimuli, 13 different web pages were used. One reason for using this number of web pages was that the time required for each session should not be too long. They were all downloaded from the internet on 9 January 1998. Eight of these were from telecommunication or electronics companies, while the five others were from other fields. Some of the web pages had been given awards for being especially well designed, and designers working in the company of the first author considered some as ugly. The web pages used were all in colour and are shown in figure 1 together with their respective web addresses. At the time of the experiment, the web pages were expanded to fill the entire computer screen.

2.3. Computer system

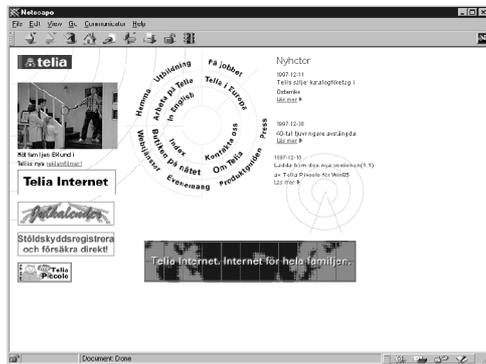
Two identical PC systems from Digital were used for the presentation of the web pages. They had identical 17



Telia Research, internal: www/.../



Telia Research, external: www.research.telia.se



Telia: www.telia.se



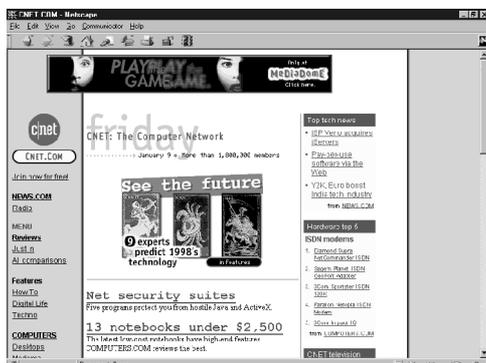
Telia Net: www.net.network.telia.se/NET/telianet.html



Tele 2: www.tele2.se



Europolitan: extern:www.europolitan.se/eurohome.htm



Cnet: www.cnet.com



Intel: www.intel.com

inch monitors, each with a resolution of 800×600 pixels at a picture frequency of 85 Hz. The contrast and brightness settings were set to equivalent values for the two monitors. For visibility reasons, each screen was tilted 18.7 degrees away from the observer.

The luminance distribution on each screen was measured in darkness with a Hagner photometer, 1° aperture, according to ISO 9241 (1992). The centres of the screens had maximum luminance values of 96 cd/m^2 and 92 cd/m^2 , respectively. At the time of the experiment, the ambient illumination brightness was set to 100 lx.

2.4. Room conditions and apparatus

Fluorescent lamps, Philips T1D 36W/83, served as light sources. These were mounted behind and above the subject. The two monitors were placed next to each other on a light brown wooden table. The person sat on a chair in front of the screens, at a comfortable distance. The distances from the eyes of the participants to the centres of the screens varied between 0.53 m and 1 m. The mean distance was 0.75 m.

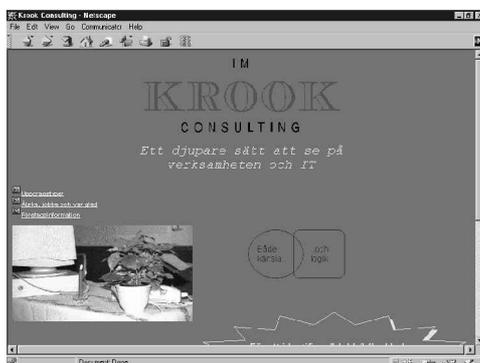
The experiment took place in a chamber where the side walls and the wall in front of the person were



National Geographic:
www.nationalgeographic.com/



Greenpeace: www.greenpeace.org



Krook Consulting: www.krookconsulting.se



Disney: www.disney.com



Loreal: www.lorealcosmetics.com

Figure 1. Web pages used as stimuli, with their web addresses as of 9 January 1998.

made out of grey, low reflecting fabric. The visual field outside of the screen and the table thus had a grey, homogeneous character. The two authors judged the colours in the room, where the experiment was being conducted. The judgements were made according to the Swedish colour standard, Natural Colour System (NCS) (Swedish standard SS 01 91 02, 1989). The colour of the upper part of the plastic bezel around the screen and the colour of the cloths in front of the subject corresponded to NCS-1000 and NCS-4500, respectively, while the table corresponded to a value between NCS-3020-Y30R and NCS-3030-Y30R.

2.5. Task and procedure

After an introduction to the experiment and the eye sight tests, the participant was taken to the room where the experiment was set up. The instructions were given in writing and then verbally, if needed. The person was seated in front of the two monitors. The task in the first session was to make pairwise comparisons between the web pages. For each pair, the participant was to indicate his or her judgement of similarity and of preference, respectively, between the two web pages. There were two scales with the endpoints indicated. The English translations of the end points of the similarity scale were named 'Fully similar' and 'Fully dissimilar' with no other designations. The endpoints of the preference scale were 'Left hand web page preferred completely' and 'Right hand web page preferred completely' with the middle point designated as 'No difference'. The participants wrote down their selections on a piece of paper. There was no time limit for the experiment and the participants could take as much time as was needed to make their judgements. They were not permitted to use the keyboard or the mouse and the experimenter changed the web pages. The web pages were presented in a random order and position (left or right), so that possible effects of order and position were balanced out.

After a short break, the person was seated in front of only one monitor. The other monitor was turned off. The task was now to judge each of the web pages on seven bipolar category scales divided from 1 to 7 in equal steps. The English translations of the Swedish labels are Complexity, Legibility, Order, Beauty, Meaningfulness, Comprehension, and Overall Impression. For example, 'very bad overall impression' and 'very good overall impression' were designated 1 and 7, respectively, at the endpoints of the scale for Overall Impression. As previously, no time limit was

given and the experimenter changed the web pages. The web pages were presented in a random order to each participant.

The scales were described on a separate piece of paper. Complexity describes how complex and ambiguous the web page is, in contrast to being simple and clear. Legibility describes how legible the page is, i.e. how the graphics, typography, layout etc., appeared. Order describes how ordered the page is, i.e. if it was clear and distinctly structured. Beauty was indicated by how beautiful and appealing the person thought the page to be as opposed to how ugly it was. Meaningfulness meant if the page was judged to be meaningful, as opposed to meaningless. Comprehension describes if the page was easy to understand, as opposed to being difficult to understand. Overall Impression meant the total impression that the web page gave, ranging from very bad to very good.

3. Results

3.1. Analysis A—Similarity data

The similarity judgements of the subjects were analysed by the Statistica (StatSoft 1995) program. According to Borg and Groenen (1997), it uses the Guttman-Lingoes initial configuration and employs the MINISSA algorithm (Roskam and Lingoes 1981), which does an ordinal multidimensional scaling. A screen test and the number of objects indicated that three dimensions would be optimal. The heuristic rule of Kruskal and Wish (1978), states that $I-1 > 4R$, where I are the number of stimuli and R are the number of dimensions. Since I was equal to 13 objects, R should not be greater than three.

The MDS solutions were interpreted by visual inspections. The main criterion was interpretability. Two of the dimensions are illustrated in figure 2. These are superimposed on the axis of the solution found by the program. The overview dimension describes how lucid, clear and easy to understand the web page is. For example, Teli Research external and Krook consulting web pages are highly loaded on this dimension. The second dimension was interpreted as a web page containing mostly illustrations (or pictures) or mostly text. For example, the Disney web page has many pictures.

The third dimension, which is not illustrated here, describes the existence of an underlying structure. The web pages are clustered into different groups depending on their geometric structure, where symmetry is one component. The groups found were:

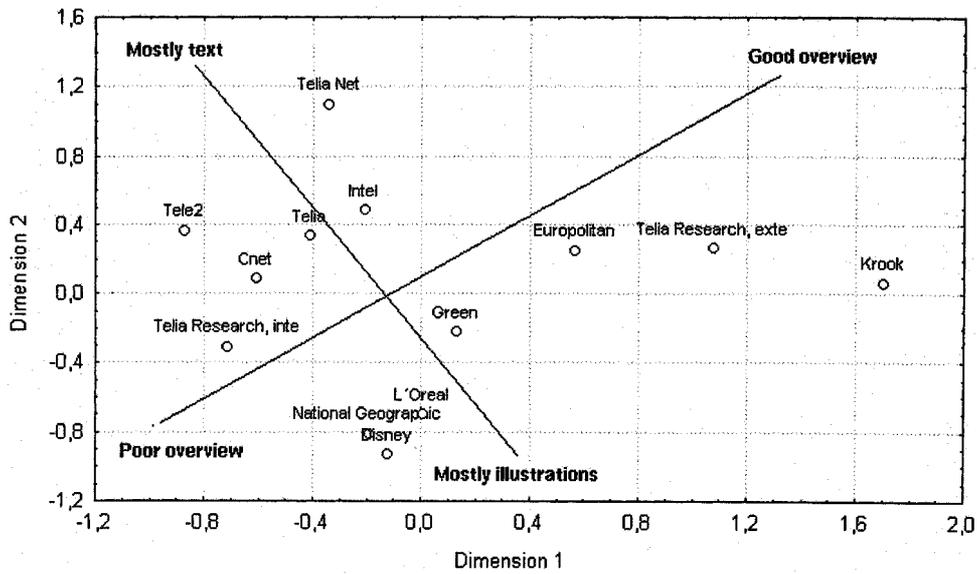


Figure 2. Two of the dimensions superimposed on the axis of the MDS solution for the similarity judgements of the web pages.

- web pages with two clear divisions on the page;
- a strong symmetrical form;
- a compromise between these two; and
- no discernible simple structure.

One web page, of the perfume company l'Oreal, was located by itself. This page had artistic balance, as in a painting, rather than the symmetric balance mentioned above.

3.2. Analysis B—Preferences

The preference judgements of the participants were analysed by the program Multidimensional Analysis of Preference Data (MDPREF) which was developed by Chang and Carroll (1969). MDPREF uses a vector model for the representation of the MDS solution. The individual participants and each object are shown as vectors. The highest preference for a participant is located at the end of that individual's vector. Vectors in the same solution also represent the average preferences for the objects. One may thus inspect the preferences of a particular individual for the different objects and also compare these preferences to those of the other participants in the study. Although the sequential approach of MDPREF has been criticized (Borg and Groenen 1997: 257), it is still a popular program especially in market research. A three dimensional solution was selected. Criteria were interpretability and the heuristic rule of Kruskal and Wish (1978), mentioned above.

The three dimensions were beauty, mostly illustrations versus mostly text and overview. The first two dimensions are seen in figure 3, along with the vectors for each person. Two dimensions found for the preference data were thus interpreted to have the same meaning as the dimensions of the similarity data, viz. overview and mostly illustrations versus mostly text. The third dimension, which was not found for the similarity judgements, was interpreted as a beauty dimension. Support for this interpretation was given from the values on the category scale beauty, since this dimension fairly well describes the web pages with high ratings on this scale.

One may notice that several of the subjects tended to prefer web pages in the upper or left part of figure 3, i.e. those that were interpreted as beautiful or graphically dense.

3.3. Analysis C—Category scales

The mean values for the web pages using category scales are shown in table 1. It is evident that some web pages are consistently given higher mean values, while others are seen in a less positive light. It should be noted that a high value on the complexity scale actually means lack of complexity, i.e. simplicity.

In order to determine what factors were important for the overall impression of the web pages, a multiple regression was performed on the category scales, with the Overall Impression scale as the dependent variable and the other six as the predictors. The means of the two

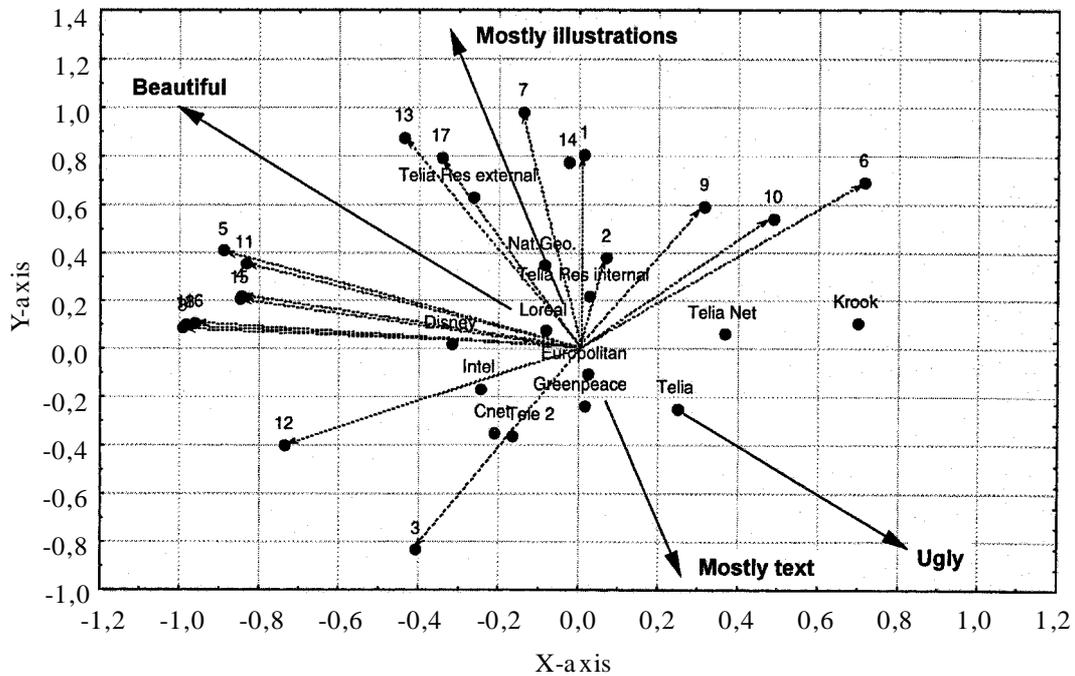


Figure 3. Two of the dimensions superimposed on the axis of the MDS solution for the preference judgements of the web pages, with numbers representing each participant's preference vector.

Table 1. Mean judgements of the category scales for the web pages.

Web page	Category scale						
	Complexity	Legibility	Order	Beauty	Meaningfulness	Comprehension	Overall Impression
Telia Research – Internal	4.02	4.46	4.05	3.88	4.28	4.89	4.39
Telia Research – External	6.42	6.48	6.49	5.66	4.58	5.87	5.80
Telia	4.22	4.19	4.02	3.45	4.06	4.63	3.87
Telia Net	5.43	5.61	5.53	3.12	4.03	5.34	4.28
Tele2	2.96	4.18	4.06	3.68	4.46	4.86	4.29
Europlitan	5.68	5.34	5.74	4.26	4.58	5.65	4.97
Cnet	3.19	3.95	3.97	3.68	3.97	4.05	3.99
Intel	4.01	4.32	4.72	4.43	4.18	4.71	4.67
National Geogr.	4.13	3.88	4.40	5.08	4.64	4.24	4.90
Disney	3.99	4.17	4.44	4.51	4.30	4.83	4.59
Greenpeace	4.28	4.17	4.67	3.93	4.88	4.26	4.16
Krook Consulting	6.01	5.32	5.01	2.70	3.08	4.45	3.31
L'Oréal	4.13	4.75	4.59	5.55	3.94	5.21	5.41

judgements of each subject were analysed for each web page and scale, 234 cases total. The result was $R^2 = 0.86$ (adjusted), with $F(6, 227) = 231$, and significance at the $p = 0.05$ level.

The non-standardized B-weights for complexity, legibility, order, beauty, meaningfulness and comprehension were -0.11, 0.26, -0.03, 0.64, 0.12 and 0.25, respectively, with t -values of -2.9, 4.9, -0.60, 23.0, 3.7 and 5.2, respectively, all except that for order being significant at the $p = 0.05$ level. The highest t -value was

for beauty as an indicator of overall impression. A similar regression analysis with beauty as the dependent variable showed that its best predictor was Overall Impression.

In order to further understand the relations of the category scales to each other, a principal component analysis (see, e.g. Gorsuch 1974) was performed on the mean values of the category scales, where the web pages were the 13 individual cases. The analysis showed two factors with eigenvalues larger than 1.0, with explained

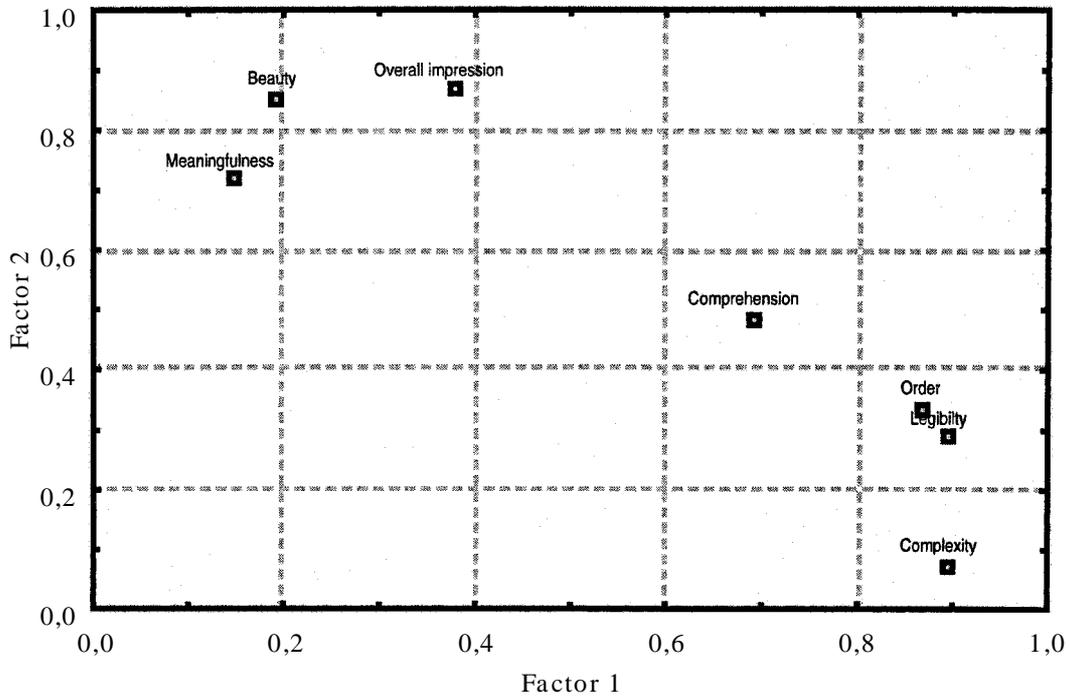


Figure 4. Factor loadings for category scales of Factor 2 plotted against those of Factor 1.

variances being 43% and 35%, respectively. The varimax-rotated solution (Gorsuch 1974) is shown in figure 4, where the factor loadings of the two factors for the variables are plotted against each other.

The principal component analysis shows that Complexity, Legibility and Order are grouped together. This grouping supports the notion of collative variables, but does not indicate their importance. The more semantic-related variables of Meaningfulness, Beauty and Overall Impression are also grouped together, indicating the importance of beauty and meaningfulness for the overall impression. The variable Comprehension falls between these two clusters of variables, but closer to the first three. Tentatively, Factor 1 in this analysis may be named a Formal factor, while Factor 2 may be named an Appeal factor.

3.4. Analysis D—Property vector fitting

In Analysis A, B and C above, the similarity data, preference data and category scales ratings, respectively, were analysed separately. In order to relate the data from the two MDS analyses to that of the category scales, the program Property Fitting by Optimizing Nonlinear or Linear Correlation (PROFIT) by Chang and Carroll (1968) was used. The result of this was Analysis D. PROFIT is a multidimensional procedure

that relates a stimulus space to independently determined physical attributes (or scales) called properties. In property vector fitting, hypotheses about stimulus attributes are represented by, for example, category scales, which describe characteristics of the stimuli. If the parameter embodied in a property scale is important for the group being investigated and assuming that stimulus differences of the attribute were used to judge similarity (or preferences), then the ratings of that scale should be predictable from the MDS-derived configuration (Jones and Koehly 1993).

The starting co-ordinates were the results from analyses provided from the previous multidimensional scalings. For the similarity data, the input was the final configuration for the dimensions and the web pages, which had been obtained from the Statistica package in Analysis A using the MINISSA algorithm. For the preference data, the original stimulus space used was the so-called normalized stimulus matrix provided by the MDPREF program in Analysis B. The 'physical' attributes in this context are the mean values of the category scales for each web page as provided through Analysis C.

The direction cosines of fitted vectors in normalized space for the similarity data from Analysis A and for the preference data based on the normalized stimulus matrix from Analysis B are shown in tables 2 and 3, respectively. These constitute Analysis D. A linear

approach was used in these analyses. The tables show the correlations between the property vectors and the underlying dimensional space.

The resulting PROFIT analysis for the similarity data of Analysis D (see table 2) shows that the vectors for Complexity and Legibility are closely related by having the same direction and magnitude on one of the dimensions. Lack of complexity is thus closely related to legibility, since high values on the Complexity scale indicated simplicity. A second dimension is characterized by the Overall Impression, Legibility, Comprehension and Order vectors, giving support to the overview dimension identified in the similarity analysis and shown in figure 2.

The PROFIT analysis for the preference data of Analysis D (see table 3) shows that Complexity and Meaningfulness have opposite directions in one dimension. Complexity is also related to Legibility and Order in that dimension. A second dimension shows that Beauty and Meaningfulness have the same directions. Beauty and the Overall Impression form the basis for a third dimension. Thus, the Beauty scale played a more prominent role in the preference data than in the similarity judgements. This supports the Beauty dimension identified in figure 3 of Analysis B.

Table 2. Direction cosines of fitted vectors in normalised space for the similarity judgements.

Vector	Dimension		
	1	2	3
Complexity	0.84	0.44	0.33
Legibility	0.73	0.67	0.16
Order	0.62	0.70	0.37
Beauty	-0.57	-0.68	-0.47
Meaningfulness	-0.50	-0.06	0.87
Comprehension	0.62	0.67	0.42
Overall Impression	-0.06	0.90	0.44

Table 3. Direction cosines of fitted vectors in normalised space for the preference judgements.

Vector	Dimension		
	1	2	3
Complexity	0.91	0.40	-0.11
Legibility	0.70	0.59	0.40
Order	0.74	0.51	0.43
Beauty	0.05	-0.58	0.81
Meaningfulness	-0.85	-0.52	-0.06
Comprehension	0.43	0.58	0.69
Overall Impression	0.07	-0.32	0.95

4. Discussion

The similarity judgements for the web pages, Analysis A, showed illustrations versus text, overview and possibly structure to be important dimensions. The preference analysis, Analysis B, indicated that the important dimensions are illustrations versus text, overview and beauty. The category scales, Analysis C, showed that Beauty was an important predictor of the Overall Impression. Different kinds of measures thus indicate that the beauty of a web page is an important factor determining how it will be experienced and judged. The overview dimension found in this study, was also shown by Severinsson (1992) to be important in the context of work with computer displays, especially when the person is using a word processing program.

The property vector fitting between the similarity and preference judgements with the category scales, Analysis D, indicated that (lack of) Complexity, Legibility and Order are important components of one dimension in both MDS spaces. Beauty was a stronger component in the preference space. For the similarity space, Overall Impression is in the same direction as Order, but Order is in the opposite direction to Beauty. In the preference space, the Overall Impression and Beauty scales were in similar directions as seen by the cosine angles. Thus, observers may judge web pages to be similar based on the amount of Complexity, Legibility and Order, but they may like them based on their Beauty.

The scales—Complexity and Order—proposed by Birkhoff (1933) and Berlyne (1971) in the classical experimental literature of aesthetics do not seem to be important for how the appeal of web pages was experienced in the present study. Judging from the preference data, a combination of pictures and beauty is important for the appeal. We assume here that the preference of a web page is closely related to its appeal. Schenkman and Fukuda (1997) arrived at a similar conclusion in a study of systematic variations of one web page. The conclusions in this paper are supported by the results of the factor analysis. The participants apparently group Overall Impression, Beauty and Meaningfulness together at the high end of the Appeal factor, while Order, Legibility and Complexity are at the high end of the Formal factor.

These interpretations of the results support the critical views of the behaviourist approach of Berlyne (1971). Aesthetic communication, i.e. how observers perceive objects of art, does not only involve the properties of the object, but also the 'decoding' and interpretation of the observer. However, Berlyne's work is still a fundamental work of experimental aesthetics (Cupchik and Heinrichs 1981).

This study was of the first impressions of web pages. The subjects were further limited in that they could not use the keyboard or the mouse. A user's preference for a particular web site in a practical situation will probably also be influenced by factors such as usability, information richness, loading speed and relevance. We believe that the first impression of a web site is important if the user continues to use the web site.

The close association of Meaningfulness and Beauty for the Appeal factor (in figure 4) leads credence to Crozier's (1994) views that meaning is important in the design of products. The other clustering of Order, Legibility and Complexity gives support for Crozier's other two aspects, i.e. form and function.

Based on this study, practical recommendation for web designers is to make the web page give a good overview and overall impression. The external page of Telia Research had the highest rating for all the category scales except for Meaningfulness. To a certain extent, the participants could have been influenced by the fact that the study took place within Telia Research. On the other hand, neither the internal page of the same company nor of its mother company, Telia, were rated as favourably. The external page of Telia Research also had a high weight for the overview dimension of the similarity data (figure 2). It thus seems that overview is important not only for work with computers (Severinsson 1992), but also for the perception of beauty on web pages. One may observe that no performance was required of the subjects in this study. If performance had been required, the black background of Telia Research might not be appropriate, since a black background is not always a recommended ergonomic choice for computers (ISO 9241 1992) and has been found to lower legibility on web pages (e.g. Schenkman and Fukuda 1997).

For the first impression it is more advisable to have more illustrations than text. However, this last recommendation has to be balanced with the demands of the loading time of the computer, since it takes more time to download a web page full of graphics than to download a text page. Some of the pages in this study had advanced design elements such as printed text written in a circle. However, these designs may be difficult to read and can lower the appearance of the web page because of their complexity. The colour content of the web pages was not examined, but colour would be expected to be one of the important factors for the preferences and the beauty ratings.

One determining factor for beauty or appeal in the present study was probably visual symmetry (Szilagyí and Baird 1997), since overview and structure indicate the relevance of symmetry. This factor was also assumed to be relevant for aesthetic perception in the study by

Szilagyí and Baird (1997). However, as seen in the present study, semantic as well as syntactic factors, i.e. meaning and form, are important for how some manmade objects are viewed. Cupchik and Heinrichs (1981) stress the emotional and holistic aspects of the appreciation of visual art. The methods of multidimensional scaling appear to be a fruitful way of understanding these aspects of information technologies.

At the beginning of the industrial revolution in nineteenth-century Britain there was a flood of new products, with new functions and new kinds of design, some of them not tried or even seen before (Heskett 1980: 19). Academic research at that time (Heskett 1980) tried to determine the most suitable form for products, while manufacturers looked everywhere in search of novelty. In our opinion, the situation in web design today is, in some ways similar to the one about 150 years ago with new services and products being introduced at a fast rate. We hope to have bridged the present gaps between designers and researchers.

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