In: Eibl, Maximilian; Wolff, Christian; Womser-Hacker, Christa (Hg.): Designing Information Systems. Festschrift für Jürgen Krause. Konstanz: UVK Verlagsgesellschaft mbH, 2005. S. 157 – 170.

Natural Design

Some Remarks on the Human Nature and the Design of User Interfaces

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Abstract
In the last years evolutionary biology made great progress. It is most interesting that recently studies consider not only the physical evolution but also the cognitive one. Here it is for example by now widely accepted to assume a co-evolution of brain and language. This would mean that linguistic structures are dispositioned within the human brain – and therefore intercultural.

Of course one firstly thinks of Chomsky's generative grammar. But research goes beyond that and discusses the biological foundations of structuring knowledge in general. Passing on knowledge by narration is one of many examples. This article discusses whether evolutionary biology can provide ideas and concepts to naturally designed interfaces.

1 Beautiful People and Usable Systems

In 1995 *Kurosu & Kashimura* introduced the term *apparent usability* to describe a subjective a priori perception of usability. They describe a study on the design of a cash dispenser. 252 subjects were asked to rate 26 different layout-patterns concerning usability and beauty. Since the subjects were neither usability experts nor could they work with the displays they could only rate the subjectively perceived usability – not the actual existing usability. The study clearly demonstrated that people have a very specific opinion of usability even without using a system:

> This suggests that the user may be strongly affected by the aesthetic aspect of the interface even when they try to evaluate the interface in its functional aspects and it is suggested that the interface designers should strive not only to improve the inherent usability but also brush up the apparent usability or the aesthetic aspect of the interface. (*Kurosu & Kashimura* 1995: 293)

Considering this quick judgment of usability by the user leads to critical questions:

1. Can the subjectively perceived usability be affected by the actual objective usability? Is the user doomed to encounter a major disappointment when using a system which only pretends to be usable? How lasting is the effect of apparent usability?
2. Vice versa: Can the actual objective usability be affected by the subjectively perceived usability? Or will the user be able to use a system efficiently just because he thinks it is usable?
3. What elements are responsible for the perceived subjective usability? What exactly makes a (hopefully: usable) system also to appear to be usable?

Little research has been done concerning these questions though they seem to be shaking the foundations of HCI.

Keinonen 1998 describes the problem of *apparent usability* for HCI at the example of mobile phones. Here, the wish of making each function visible by a separate input feature strongly conflicts with the amount of available space. It is simply not possible to have a one-to-one correlation between functions and buttons. Thus, each button has to represent several functions. But the more functions a button represents the harder to use the mobile phone is (*Hall & Keller* 1997, *Müsseler et al.* 1996). A similar problem is also reported by *Norman* 1988 for car radios. To put it simple: the more buttons are there for showing the available features the easier a device is to use.[1]

Unfortunately, this simple rule of usability strongly conflicts with a rule of *apparent usability*: the fewer buttons a mobile phone has the easier to use it *appears* to be. Thus, users tend to buy mobile phones with fewer buttons wrongly thinking they are easier to use. *Actual usability* is in strong contrast to *apparent usability*.

There are two interesting points in the studies of *Keinonen* and *Kurosu & Kashimura*:[2] First of all they introduce the dichotomy between actually existing and subjectively perceived ergonomic quality. This has severe consequences. If a user interface appears to be hard to use, users build up negative emotions like anxiety, fear of intellectual overload, or simply rejection. These emotions again really can handicap the operation of a machine: People less confident in their abilities usually also perform worse. Thus, even the most usable inter-

[1] This is admittedly an oversimplified description of the problem but will do here in order to make the point.
[2] These studies were confirmed in a different cultural environment by *Tractinsky* 1997.

face can turn out to be unusable because it hinders the user psychologically. Vice versa an invitingly designed user interface may help the user to manage ergonomically imperfect software. Therefore, it is most important not only to build ergonomic interfaces but also to pass on the ergonomic quality of the interface to the users feeling.

But what makes the user feel ergonomics if not ergonomics itself? This is the second interesting point in the studies of *Kurosu & Kashimura*: They claim that it is aesthetics which let's the user feel ergonomics. Concerning to their findings the aesthetically perception is responsible for the perceived usability.

The studies of *Keinonen*, *Kurosu & Kashimura*, and *Tractinsky* show the impact of the optical appearance independently of the factual quality of software. Their findings suggest the following conclusions: An ergonomic system must communicate its ergonomic quality to the user. This can be done by introducing aesthetics since the user seemingly associates aesthetically quality to ergonomic quality. Therefore, aesthetics in user interface design is not an end in itself but shows usability and enhances user satisfaction. In the end aesthetically aspects should be part of ergonomic user interface design.

Vice versa one could argue, that also aesthetics can't do without ergonomics. Even though aesthetically pleasing interfaces may lead the user to believe that he works with a usable system, it cannot replace ergonomics. Using the system will teach him the truth soon enough. *Norman* 2002 even argues that ergonomics is an essential part of design: „To be truly beautiful, wondrous, and pleasurable, the product has to fulfill a useful function, work well, and be usable and understandable." (*Norman* 2002: 42)

It is of no importance whether ergonomics should be a part of aesthetics or aesthetics a part of ergonomics. But it is of importance to state that the separation of ergonomics and aesthetics is an artificial one and should be abolished.

But what has this to do with the beautiful people mentioned in the heading? Well, the connection between the qualities of usability and aesthetics made by the user seems to relate to a similar connection known from evolutionary psychology. Here, we know a psychological mechanism that lets people judge others' based personality by their appearance: physically attracting people are assumed to have a favorable personality.

There are numerous studies showing that people tend to judge others basing on their appearance. This judgment is a fast working, unavoidable, and hard to override mechanism. Just think of a person you disliked in the beginning

and liked after a while. It takes time and you probably never forget the first impression.

For example *Dion et al.* 1972 showed pictures of people of high, average and low attractiveness to 60 subjects. (The categorization of attractiveness was empirically determined in another study.) Half the subjects had to judge pictures of male and half of female people. Altogether, there were 12 sets of photographs, each set with three people of different attractiveness. The subjects were asked to judge the three people of one set concerning 27 personality traits like altruism, kindness, strength, poisedness or sexual permissiveness. In this study subjects tend to ascribe positive characteristics more likely to more attractive people. The study even goes one step further:

> As predicted, attractive stimulus persons were assumed to have better prospects for happy social and professional lives. All in all, the attractive stimulus persons were expected to have more total happiness in their lives than those of lesser attractiveness. […] It is evident that the subjects assumed that the attractive stimulus persons were more likely to find an acceptable partner than those of lesser attractiveness. Attractive individuals were expected to marry earlier and to be less likely to remain single. […] Not only are physical attractive persons assumed to possess more socially desirable personalities than those of lesser attractiveness, but it is presumed that their lives will be happier and more successful. (*Dion et al.* 1979: 289)

Concerning these empirical findings it might not wonder *Dion et al.* 1979: 289 conclude: “The results suggest that a physical attractiveness stereotype exists and that its content is perfectly compatible with the ‘What is beautiful is good’ thesis.”

This stereotype described by *Dion et al.* is strictly based on visual observations. They do not consider the real world contact between people and the impact of other factors than beauty. Here, they refer to other studies – for example about relatively mild judgments of courts for young attractive women – in order to show the real world effects of their findings.

In a meta study *Eagly et al.* 1991 compile the results of several other studies concerning this phenomenon. Those studies basically confirmed *Dion et al.*'s finding that people tend to attribute positive characteristics to beautiful people. Though the strength of this correlation varies.

This mechanism of connecting beauty and personality is widely used by film, advertising, or literature. In fairy-tales the ugly witch eats the little children

and the beautiful prince saves redeemer-like the just as beautiful Cinderella. Here the ugly good one – like Quasimodo, the Hunchback of Notre Dame – is the exception. And even he becomes the beautiful Esmeralda – just imagine what an ugly, pimply Esmeralda with greasy hair would do to the story! On the other side: a beautiful but bad women – known as *femme fatale* – is always attracting special attention, since this combination is, at least concerning the above mentioned studies, obviously counter intuitive and therefore especially dangerous.

There are several possible biological reasons for connecting perceived beauty and associated characteristics. On the one hand it could be part of a cognitive mechanism of general stereotyping which interprets appearance and personality jointly. On the other hand the optical features might be the first of a set of classification criteria, since the physical appearance is the easiest to perceive human characteristic. The appearance than could be used to pre-arrange all other impressions or, in exceptional cases, it could also be overwritten by succeeding impressions.

There is an enormous amount of research concerning the psychological effects of attractiveness as well as the criteria of attractiveness (see for example *Penton-Voak et al*. 2001, *Little et al*. 2001). One of these criteria is symmetry. Reasoning in evolutionary dimensions the attracting effect of symmetry to possible mates seems to be reasonable since symmetry is as sign of healthiness (*Little et al*. 2001: 39). Severe damages of health from infections fights or malnutrition frequently result in a reduction of symmetry: loss of or injuries to limbs for example. Animals in this state are left considerably asymmetric. And they are most unlikely to survive long enough to reproduce. And the animals mating them will probably loose their mate and their offspring as well. Thus they are less likely to spread their genes. Seemingly in the course of time symmetry became an universal indicator of healthiness.

Nota bene: for modern human beings, physical symmetry is no longer a sign of any ability to survive. Fortunately, the loss of a leg for example does not mean one wouldn't live long enough to be able to raise children. Thus again on the long run it might be that future humans completely loose their disposition to be attracted by symmetry – because it is irrelevant to reproduction.

It is not the aim of this article to proclaim symmetrical interfaces just because symmetry seems to affect human sexual behavior. Symmetry is just one of plenty signs of phenotypic and genotypic healthiness and strength.

I am rather trying to show the biologically deeply embodied affection to aesthetics: in biology aesthetically pleasing people (and physical symmetry is

one measure of aesthetics here) are associated with desirable personalities, in software aesthetically pleasing interfaces are associated with qualities like usability. Whether or not these associations are reasonable: they do exist and they are substantial.

There are currently only few studies concerning *apparent usability* and barely a study investigating the underlying mechanism. So it is unknown which factors exactly influence the *a priori* perception of usability. After all *aesthetically pleasing* is a rather soft description and the question remains: What exactly makes an interface to be aesthetically pleasing? Do we need to care about a fully designed interface or is it sufficient to consider some simple rules of thumb?

Next to the quality of the aesthetic aspect a further question is to it's lastingness: How long lasts the first impression on *apparent usability*? How can the long-term use of software influence this first impression? *Tractinsky et al.* 2000 show that the *a priori* aspect of usability perception lasts even when users were actually working with the system. Nevertheless, users in *Tractinsky et al.*'s study were allowed to work with the tested system only for a short time. A long-time evaluation was not performed.

2 Herd Instinct and Navigation

The human being is a social one. It needs to be. Humans are week and slow. They are born too early and without any chance of survival: It takes months or years before a human being is able to walk, speak, eat something else than mother's milk, and mate. Imagine what an extravagance children were to our ancestors 100.000 years ago. The children should have been ideal prey for all predators. And finally humans never developed the typical tricks of evolution like mimicry or mimesis to defend their lives. So when the *homo sapiens* left the African continent and went to populate the whole world he was definitely not in the physical shape to be successful.

Thus, without the development of other survival strategies the human being would probably be erased by today. But humans already had developed sophisticated alternatives to physical strength: the use of tools and, even before that, the social grouping. The latter one is a strategy widely used in the animal kingdom. Not only typical prey group together for example in order to protect the offspring, also typical predators like lions hunt together in order to maximize the success.

This might be a rather simplified explanation of the origin of the herd instinct. The factual development of the herd instinct is far more complex and evolved by more factors than can be described in this short article. Nevertheless, the point I want to make here is: Evolution has brought up a cognitively deeply funded urge to gather together and built societies.

The original need to group might have been a purely physical one. Those humans (and of course their predecessors) who avoided grouping got killed and could not pass on their genes. Those who grouped together were less likely to die before passing on their genes. During the Millions of years of evolution the strategy of grouping was passed on by the genes and became part of the human character.

Today humans cannot do without grouping. They group in families, friendships, sport clubs, bars, at the cashier in the supermarket, on the school yard, in companies, in cities, states and countries. Even when leaving the earth they group together in an *International Space Station*. It seems to be a vital desire. Just think of the experiments by the German Kaiser *Friedrich II.* (1194-1250) who wanted to know the original language of mankind. He put together a group on newborn babies in a room. The wet-nurse were only allowed to breast-feed the children – no other contact and especially no talking was allowed. The idea was to let the children develop their own language without any cultural influence. This language then must be the original language human spoke before the hazard of the Tower of Babel. Well, *Friedrich II.* did not find the original human language, but he found out that human babies die a terrible death when left without social contact.

It seems that humans cannot do without others. And even more: humans developed several cognitive mechanisms to interact with others. The most obvious of these mechanisms is the herd instinct: People tend to follow others, when they are unsure about the right way. And this movement does not have to be actually a physical one; it can also be a pure intellectual one. Scientific papers for example usually emphasize the state of the art in order to make sure to be within the scientific herd.

In the last years some research has been done concerning this herd instinct and it's application in interface design. Here the term *social navigation* (see for example *Dieberger et al.* 2000, *McNee et al.* 2002) has evolved. *Forsberg et al.* 1998 define *social navigation* as follows:

> Social navigation can happen in many different forms, ranging from following a group of people that we do not know, to approaching an expert in a field asking for advice on how to find information. One may

> distinguish between *direct* and *indirect* social navigation. In direct social navigation, we talk directly to the other users. In indirect social navigation, we can see the traces of were people have gone through the space, as for example in the Footprints system.
> Furthermore, social navigation may be *intended* or *unintended* by the advice-giver. An example of intended social navigation would be when we recommend someone a place to visit, while paths through the woods can exemplify unintended navigation.
> Another distinction can be made for when the advice-giver is one particular person, known to us, or when it is just a group of anonymous users that have happened to navigate through the same space as us. In-between these two extremes, we may have groups of users that are similar to the navigator in terms of interests, profession, knowledge or task. (*Forsberg et al*. 1998: 1)

Implementing social navigation can be very simple. Amazon for example provides for every book an "*Users who bought this book also bought:*" – area which gives information about the reading behavior of other users. The underlying assumption is that other readers might have the same spectrum of interests.

This *social navigation* feature, which is implemented by other online shops as well, is a further development of a former feature based on similarity. This feature usually appears in on-line shops as something like "*Customers interested in ... may also be interested in:*" (as Amazon puts it) and presents additional products which are similar to the chosen one. If for example a customer chooses a book about the second world war, the *similarity* feature probably presents other books about the second world war. (Please be aware: Similarity here is a statistical measure about the correlation of words used to describe the product.) The *social navigation* feature presents books that other people also bought. These books do not need to be related to the second world war at all, they only belong to the spectrum of interests people who read the chosen book have – and this spectrum can be far broader than the second world war. Thus, the *social navigation* feature provides a personalized best seller list to the customer.

Most of the implementations of *social navigation* is similar to Amazon's (for example *Girgensohn & Lee* 2002). Another, less obvious but enormously successful implementation of *social navigation* is the Google ranking. The Google ranking breaks with traditional ranking principles by introducing a *social navigation* component: A page is ranked higher the more other Internet resources link to this page. Since these links are set by somebody willingly

and for some reason, they can be interpreted as a recommendation. Thus, pages which are often linked to are often recommended.

The interesting thing about *social navigation* is that it might show paths of navigation which are hidden otherwise (see the Amazon example) and that can support concepts like authority. In other words: Social navigation opens the content of a web page to the user. His behavior influences the presentation of the content.

And this is also the pitfall of *social navigation*. It is technically rather simple to imitate user behavior. In order to trick the Google ranking all you need to do is to create a so called link farm: thousands of web domains which link to each other.

Such tricks are also common in real life, for example in order to get people into a cocktail bar. People are very reluctant to enter an empty cocktail bar. So the owner introduces an happy hour with all drinks at half the price. He might not do any profit during this happy hour, but there are already people in the bar and people passing the bar are more willing to enter.

3 Water-holes and Structuring Information

In western civilization the most common way of structuring information is by hierarchies. Just think of information presentation in common menus in interface design, navigation in web sites, or information representation in ontologies. Hierarchies seem to be a natural way of structuring information: Our whole life seems to be influenced by hierarchies: within the public order, companies, military, even within informally structured groups like peer groups and families. Even if one looks at our ancestors or our relatives, the primates, hierarchies influence their lives too: Their groups are usually dominated by an alpha-animal.

But is the concept of hierarchy really that natural? *Blake et al.* 2001 report a study of a system enabling expert animal trackers to communicate their findings to the scientific community. These animal trackers came from a South African hunter and gatherer background and were illiterate. They had to use a hand held device which served as a tool for documenting animal sights. The interesting point of this study is that the trackers had serious problems with an initially used hierarchical structure of the interface. They preferred long lists:

> The classification system used in the interface was found to be less useful than expected in assisting the trackers in finding the relevant animal

> in a list or set of sequential screens. The trackers appeared to make more use of the position of the animal in the lists than of their position in a hierarchical classification of animals, e.g., hooves (large or small) versus pads (with claws or without). Thus certain intermediate screens which would have resulted in a reduction of the number of animals to be paged through in the final list, were removed in favour of longer lists. (*Blake et al*. 2001: 5)

In his article *A City is Not a Tree* Christopher Alexander describes the general structure of cities. First he distinguishes between *natural cities* (cities that have been growing for centuries) and *artificial cities* (cities that have been designed on a drawing-board like Brasilia or modern suburbs):

> It is more and more widely recognized today that there is some essential ingredient missing from artificial cities. When compared with ancient cities that have acquired the patina of life, our modern attempts to create cities artificially are, from a human point of view, entirely unsuccessful. (*Alexander* 1965a: 58)

Whereas an artificial city is planned in advance a natural city is formed by actually living in it. Thus, the hierarchical structure of a city is due to the need of the architect to keep an overview on the ingredients of a city in order to be able to arrange the city by its assumed needs:

> The units of which an artificial city is made up are always organized to form a tree. So that we get a really clear understanding of what this means, and shall better see its implications, let us define a tree once again. Whenever we have a tree structure, it means that within this structure no piece of any unit is ever connected to other units, except through the medium of that unit as a whole.
> The enormity of this restriction is difficult to grasp. It is a little as though the members of a family were not free to make friends outside the family, except when the family as a whole made a friendship.
> In simplicity of structure the tree is comparable to the compulsive desire for neatness and order that insists the candlesticks on a mantelpiece be perfectly straight and perfectly symmetrical about the centre. The semilattice, by comparison, is the structure of a complex fabric; it is the structure of living things, of great paintings and symphonies. (*Alexander* 1965b: 58)

The hierarchical tree is what the city planners (and probably the authorities as well) wish. The rather unpredictable semi lattice is what real life creates. The hierarchical structure – as a simplification of the real world – seems to result

from the need to keep control on a structure. It seems to be the structure which is preferred by those in charge. The semi lattice is the structure that evolved without major planning. The resulting city is less predictable / controllable / navigationable. But it is closer to the way people are living. The concept of hierarchical structures becomes less convincing the more you think about it. But what could be the alternative?

During a great drought the Australian *Paralij* lead his tribe *Nangatara* over 600 kilometers from water-hole to water-hole. He had never walked the way before. He had no modern aids like a map or a compass. His knowledge about the way was a traditional one: Nearly half the way he knew from his initiation, the other half from a ceremonial cycle of his tribe. (see *Heeschen* 1988: 197)

Narration, in form of myths, ceremonial cycles or simple stories, seems to be a most natural way of communicating information. Narration is used to explain unexplainable natural phenomena by personalization: The ancient Greek god Poseidon suites well to describe the unpredictable and often enough dangerous behavior of the sea. It is an explanation as well as a warning told in an easy to remember way.

The earliest forms of narration probably were magic spells created and passed on by a religious caste. They usually base on markings like verse and rhyme – two typical mechanisms of mnemonics. Structuring expressions in verse and rhyme has one big advantage: you always know missing or falsely arranged elements. A dissolved rhyme or a stumbling verse is interpreted as an error in the message.

The expectation that a verse is kept in time an a rhyme is completed is quite similar to a phenomenon known from visual perception: the Gestalt phenomenon. It is well known that the human brain interprets visual perceptions as a whole – leading to the laws of Gestalt.

Gestalt also identifies coherence. And it does not only within rhymes. Modern literary studies discuss the concept of *innate plots* or a *narration instinct* (see for example *Heeschen* 2001). At a first glance it seems that this might be a proper way of storing procedural information. But the above mentioned examples of the city as not being a tree and the Australian who lead his people along 600 kilometers show that also static information (here geographical information) can be represented in different ways.

I admit: structuring information is a topic that deserves more space than is provided here. It is a rather naive attempt to describe these thoughts on only

three pages. Nevertheless, despite the reduced character of this description it should be comprehensible that evolutionary psychology might provide new aspects on the appropriate structuring of information.

4 So What?

The human brain is not an universal machine but involves several predefined mechanisms and dispositions which influence human behaviour and human thinking. This article provides three examples of how these dispositions might affect the use of information systems. The advantage of considering these dispositions lies in their independence on cultural influences as *Kogan* 1997 states for the perception of human attractiveness:

> The cross-cultural stability of these findings undermines the notion of cultural variations in physical attractiveness, suggesting instead that individuals are equipped with a set of beauty detectors that manifest little inter-individual or inter-cultural variation. (*Kogan* 1997: 194)

By appealing those dispositions information systems might extraordinarily enhance usability independently of the cultural environment. In the ideal case the findings of evolutionary biology can serve as a toolbox for the conception of information systems.

Unfortunately there is a catch in this idea: First, the findings of evolutionary biology are usually rather vague considering their applicability to information systems. They can serve as general ideas but not as explicit road maps to system design.

Second, evolutionary biology attracts many rather dubious people who postulate unacceptable assertions. Evolution might serve to postulate various things but it is usually quite hard to find real evidence – and it is equally hard to find real counter-evidence. But this suspiciousness is not applicable to information systems. Here, user tests will eliminate false hypothesis.

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