Klaus Schwarzfischer

A Systemsemiotic Approach to Design.

Abstract

1. I will start aquiring three aspects from Visual Research: First is the „Level of Detail (LOD)", which is of quite a relevance [Luebke et al. 2003]. Every scene is of infinite information, because any detail has details itself, and so on. This successive process of observation is stopped by the observer, when he feels to be „sufficiently" informed. This diachronous process starts at medium spatial frequencies and stopps at higher spatial frequencies (band-pass-filter) [Hauske 2003; Goldstein 2002]. As a second aspect I have a look at the maximum density of receptors, which decreases towards the periphery. We can interpret this as a bandpass-characteristic again - here in a spatial dimension [Hauske 2003; Goldstein 2002]. The third aspect is the Blind Spot. This local lack of receptors (structural features) is not seen by the observer.

2. In a second step I interpret these three aspects (diachronous periphery, synchronous periphery and Blind Spot) semiotically: We ask the heuristic question, if these features are syntactically, what the semantic and pragmatic equivalents are. The semantic perspective offers the term of „typicality", which can be analyzed both synchronous and diachronous. „Typicality" can be discrimiated in biologic, cultural und individual dynamics. The Blind Spot may be interpreted in the semantic perspective as a unability to recognize a code as a code (but as signal only).

3. The pragmatic perspective interprets the aspects in a different way again. Diachronous Periphery can mean here, that not every fact is equal important for the construcion of causality (i.e. the problems of anthropomorph knowledge or individual centered experience [Pöppel 2000]). Synchronous periphery would mean, that inter-personal effects are seen as more or less effective. For example role conflicts are relevant here. The Blind Spot pragmatically interpreted is the equivalent of moral reasoning.

4. Additionally that all can be analysed as dynamic: Every observer draws a path in the visual or cognitive space i.e. by processing saccadic [Pomplun et al. 2000] or by the observer's moves. Periphery is to be defined by the angle to the moving direction.

5. The term „presentational space" defines the perceptual space [Grush 1999; Bartels 2002]. Different from this the „representational space" is a pure mental space, which has no causal determination from outer reality. Second order observation [von Förster 1999] in „representational space" (conscious reflection) reduces attention in the „presentational space" (perception) to the

level of first order observation (pre-attentional syntactic field effects) [Jung-Beeman et al. 2004].

6. The observer frequently switches from „presentational space" to „representational space" and so on. This seems to produce a self-stabilizing oscillation. Maybe this sweeping into the complementary space will always prefer the basic level [Rosch 1978] to enter each cycle.

Keywords: Semiotics, syntactic, semantic, pragmatic, Blind Spot, diachronous periphery, synchronous periphery, basic level category, presentational space, representational space, effectivity, efficiency.

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An astonishing experience for me was the fact, that I met no designers on conferences where I should expect them. For example, at the *Tübinger Wahrnehmungs-Konferenz* (Conference on Perception in Tübingen) or the *Int. Congress on Empirical Aesthetics* there was so little designer's presence that I could have felt lonely. But is this any problem at all? I believe that there is a problem, even if it isn't perceived. The crucial point is, that the fact of not being perceived is even the centre of the problem. Because there is no way to design solutions for problems that aren't seen. This is the main direction this talk is trying to develop a systematic model, which is useful to avoid (some of this) *Blind Spots.*

I would like to develop an approach to design, which adopts three concepts from visual research and extends these concepts towards a systemsemiotic model of design. Semiotic is used as a heuristic method, which allows to interpret the three basic concepts each in a syntactic, a semantic and a pragmatic point of view.

And, of course, we may ask in the context of this conference, what the implications for design are. But these implication I will keep for the end of my talk.

Basic Concepts from Visual Research

Starting at the empirical view on visual perception, I will adopt three aspects from Visual Research. Therefore I will make a short excourse to introduce the concepts, which I will extend later:

The first is the *Level of Detail* (LOD), which means that every form is actually perceived only in a specific resolution. It is of no sense to design in a much

greater resolution than the observer uses in perception. The *Level of Detail* is very relevant in design contexts [Luebke et al. 2003], because every design problem is connected to economic perspective (even if designers often are not very fond of this fact). The ressources are limited in every case. The client may be very generous in a project, but nevertheless the ressources are limited. This is the case in economics as well as in biology, where ressources must not be wasted at all. We can find this perfectly in the field of perception: Every scene is of infinite information, because any detail has details itself, and so on. You can easily imagine this by using a everyday scene. Maybe you have been travelling by airplane to this conference. In this case you could have seen the shape of the town already from far before landing. Coming down the buildings grew larger in your perception, due to reducing distance. And as the relative size of the buildings increase on the retina, you discover more and more detail. But if you would continue the process, you would discover more and more details. Even on what has been just details itself a little time before. And with instruments like microscopes you could go on infinitely discovering details on details. And this basic perception is a temporal one. This means, that we really perceive bigger forms faster than smaller ones, even if there is no movement towards the scene. In other words: Different elements of a scene are perceived at different points in time as is shown in figure 1 (right diagram).

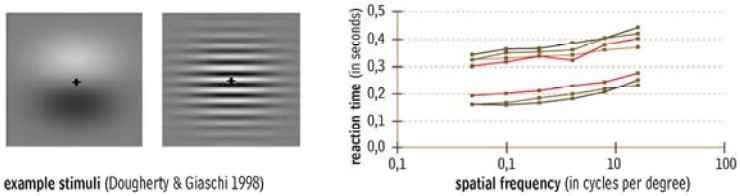

Fig. 1 – Example stimuli (left) and results (right) of Dougherty & Giaschi 1998)

This successive process of observation is stopped by the observer, when he feels to be „sufficiently" informed. To describe phenomenas *spatial frequencies* are use. This term defines the size of an object in relation to the observer. The *spatial frequency* is low if a little number of elements fit into a *viewing angle*. And the *spatial frequency* is high, if a large number of elements fit into the *viewing angle*. So the measure for the *spatial frequency* is *cycles per degree (cpd)*. As you already know, this diachronous process starts at the bigger forms, and stopps at higher spatial frequencies, what we perceive as fine details like textures. At a first glance what happens seems to be the application of a low-pass-filter. In the evolutionary perspective this makes sense because from that point of view smaller forms less informative than bigger forms. But very large forms are less informative again. For example we do not really have to consider cosmological dimensions in our everyday life. What we really perceive first can not be described by linear functions, as we can see in figure 2.

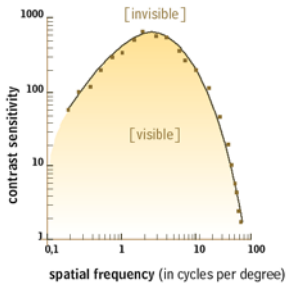

Fig. 2 – Contrast Sensitivity Function (Goldstein 2002)

So what we get is a band-pass-characteristic of perception [Hauske 2003; Goldstein 2002]. First we perceive what we are most sensitive for, and then, in succession what we are less sensitive and so on. This is what I would like to call the *diachronous periphery*. Of course, the term *periphery* only makes sense in difference to a concept of a *center*. I will use the term center in this context for the most sensitive region of the Contrast Sensitivity Fuction (figure 2). This determines what is perceived first. But an analogous phenomenon can also be found without analyzing the time axis.

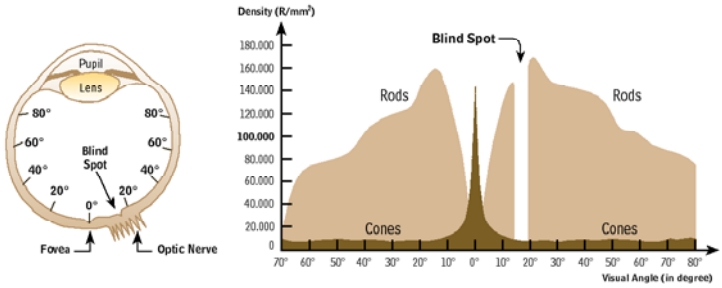

Fig. 3 – Sensor density in the Eye depending on the view angle (Goldstein 2002)

As a second aspect, I propose to have a look at the distribution of the receptors over the visual field. Not only the dynamics of perception are non-linear. The maximum density of receptors is in the *fovea centralis* and decreases towards the periphery. We can interpret this as a *bandpass-characteristic* again. Here it appears in the spatial dimension what we found earlier in the temporal analysis [Hauske 2003; Goldstein 2002]. This means that we have a much more detailled perception in the center of our visual field than in the periphery. And again we are usually not perceiving this difference in perception. Usually we believe that we would see all over the visual field homogenous. This is not so. And this effect I would like to introduce as the *synchonous periphery*.

Due to this the *Level of Detail* has to be defined spatial and temporal. Luebke et al. (2003) discuss the implementation in the design of *Virtual Realities* quite in detail. But of course, the concept isn't limitied to be applied on the field of Virtual Reality and computer aided 3D design. It is a global principle, which is of similar relevance for the design of traffic signs or the analysis of advertising.

The third aspect is the *Blind Spot*. This local lack of receptors (structural features) is not seen by the observer. He is blind facing his blindness.

This should have been a short introduction only and I know that you all knew about these aspects of perception before. So let me go on to the part of my talk, where I hope to inspire you substancially.

Semiotic Interpretation of the Basic Concepts

In a second step I would like to interpret these three aspects (*diachronous periphery*, *synchronous periphery* and *Blind Spot*) semiotically: Let us assume, these aspects represent the syntactical perspective, because the features are of a pure structural nature. So we may ask ourselves the heuristic question, what the semantic and pragmatic equivalents are. For me this seemed interesting, because even rather simple (trivial) machines can be discussed with the terms of *diachronous periphery*, *synchronous periphery* and *Blind Spot*. But for sense-processing machines (humans, artificial intelligence or social systems) we need to include the dimensions of meaning (semantics) and intention (pragmatics).

The semantic perspective offers the term of *typicality*, which is an important concept in cognitive psychology [Anderson 2001]. Imagine birds for example: The first bird that comes into mind, when I mention birds will probably be no emu and no penguin, because these are in fact birds with very low typicality. A robin for example is a bird with a very high typicality. You can apply this concept of typicality on every category, of course. So I could talk about typicality of birds as well as the typicality of tables, cars, emotions or even the typicality of design theories.

The term *typicality* can be analyzed both diachronous and synchronous. Where typicality can be discrimiated in biological, cultural und individual dynamics. The synchronous analysis of typicality shows i.e. different sub-cultures. This is very close to the examples of bird with which I introduced the concept of typicality. Because a set of robins is a *sub-category* itself. Eleonor Rosch (1978) would call it *super-ordinate category* therefore. In a more extreme interpretation a sub-culture can contain a single individuum as minimum. This case can be seen as a sub-culture of a sub-culture. The diachronous perspective of typicality shows the historical axis, in which meanings change their meaning evolutionarily or culturally measurement. In other words is the diachronous perspective of typicality a general principle of what we call *fashion*.

The *Blind Spot* may be interpreted in the semantic perspective as the unability to recognize a code as a code, but as signal only. This is a familiar effect which often can be observed between sub-cultures. For example, parents often do not understand their teenagers, and do not even recognize their peer group codes as codes.

The pragmatic perspective interprets the aspects (diachronous periphery, synchronous periphery and Blind Spot) in a different way again. Diachronous Periphery can mean here, that not every fact is equal important for the construcion of causality. Satisfaction is pushed towards a rather arbitrary event more than to others. If this sounds a little abstract, imagine that every cause has a cause again. And it is a question of cultural or individual agreement, which event in this chain of causes one declares to be the „real" cause. And this „real cause" would be equivalent with what I called the centre in the diachronous sense. This cncerns the arbitrariness of magnitude too. The anthropomorphous preference of feedback-

structures, that focus a period with maximum 3 seconds, seems relevant in this context. Ernst Pöppel (2000), a medical psychologist, did a lot of very interesting research, where he studied the temporal Gestalt integration. He found, that human's ability for integration of perception into Gestalt is limited to ca. 3 seconds – and that this is also a significantly prefered rhythm in everyday life, communication and art. I think, that this ability is not only important for Gestalt integration in perception, but also for the reafferent perception of action. My thesis, that the preference for 3 second feedback structures in senso-motoric action leads to the concept of *basic-level categories* (as we know them from Eleonor Rosch [overview i.e. in Anderson 2001]), has to be explored in future. In short: Other feedback structures may be as effective, but less visible (and therefore held to be less effective). And every observer, not only humans, even technically implemented artificial intelligences will have structural determinations, which will produce preferences.

Synchronous periphery would mean for example, that inter-personal effects are more or less effective (seen as more or less effective). Role conflicts i.e. are relvant here – and a rather good example to understand this concept. But of course, we have to look at the principle in a more general way, although we can't discuss the possibilities of this approach here exhaustively. This more general perspective can be the conflict of two (or more) exclusive intentions. A teeny for example normally is not able to stabilize the family, in which he grew up, and – at the same time – to increase the „coolness-factor" (resp. the *social status*) in his peer-group of teenies. He will have to decide, wether he wants to push one or the other. And growing up we all are involved in much more than two contexts, in which we consider this one as the center and automatically discount the other one to be periphery. Personal roles are differently efficient in different social contexts.

The Blind Spot pragmatically interpreted is the equivalent of *moral reasoning*. Mostly disregarded (not being seen!), that one ethic/moral is reasoned by another, which is not really reasoned - and so on. In other words this is the problem of the 2nd-order observer [von Förster 1999], who is always and necessarily also a 1st-order observer too, who can't reflect upon the reflections upon the 1st-order observer at the same time. This point will also be a subject of further investigations in the future.

Interpretation of Dynamic Paths

Additionally the syntactic, semantic and pragmatic perspectives can be analysed as dynamic phenomenas. Just consider, that the very most observers and agents move in space. In a biological background, of course, there are also trees and other beings, which do not move a lot. But in the context of design theory we are much more interested to model humans or robots, who do move. Every such observer draws a path in the real, visual or cognitive space i.e. by processing *saccadic* movements of the eye [Pomplun et al. 2000]. So you can imagine the whole observing system moving around (i.e. while driving throug a city) or that only a sub-system of the observer is moving (i.e. the eye of the observer while reading a newspaper).

Syntactically pictures are not observed simultanous, but successive scanned. What the observer actually sees, depends on the path his motion draws into the environmental space, because the attribute „peripheral" is to be defined in relation to the fixation. Different paths of observers lead to very different observations.

Such an observer is relativizing his observation reciprocally. Scientific ergonomics deal a lot with this syntactic aspect of who is able to see what in which situation. And the design implications are already drawn too, i.e. when the question is answered, where to place a warning signal has to be placed to be seen in a certain situation and how extensive it has to be.

Semantically relevant is the embedding of signs/objects into its context. Super-systems of a sign determine its meaning as much as its sub-systems. This reciprocal determination of part and entire is characteristic for hermeneutics. And again it is important what parts of a meaningful complex are observed in which sequential order. Because the earlier element determines the meaning of the following ones – and vice versa. Additionally it is to be considered how the levels of structure are following each other. It is a difference, if you are operating from the lower level to the higher ones (*bottom-up*) or if you are defining the meaning of a word by using the intention of the text in whole (*top-down*).

Pragmatically interpreted such observer-paths through semiotic spaces are corresponding with the involvement of the observer, what means his interest of recognition. The transitions from one motivation to another (more or less similar, more or less peripheral) motivation may be drawn as a pragmatic *motivation map* analogous to a syntactic *activation map*[Pomplun 2000]. These pragmatic perspectives can be seen close to the dealing with (e)motivational aspects, which can't be discussed here exhaustively, but should be mentioned briefly.

Syntactic, semantic and pragmatic errors

If we expand this dynamic perspective again, using the implications it offers. We can easily see that any operational mode has to be a dynamic one, because the operations can be defined as transitions from one state to another. This mode of observation can discriminate different kinds of errors semiotically, because different kinds of problems can occour when processing.

Syntactically viewed errors are typically „reading errors", where one sign is mistaken for another. This well known form of error is a simple one. If you have ever dialed the wrong number, you probably know this kind of reading error.

Semantically interpreted errors are „false methods". Instruments are used, which are not able to manipulate the parameters in the way they cybernetically should. Examples for this category of errors can be the case, if you try to dial a number on a mobile phone in winter without taking your gloves off. When you failed in dialing therefore, you chose an inappropriate methode to dial.

Pragmatically seen errors are „system errors", in that a problem is defined in a false or adverse way. This is about the correct solving of the false problems. Let me give you an example: In Germany there is a wide discourse about a lack of economic growth. But nearly no one is considering that growth might not solve the problems we have in a sustainable way. Growth might even make the situarion worse.

Relevance for Design and Economics

These perspectives are relevant in operational design (as in operational art too) and are playing a important role in design research – which consists not only of market research and ergonomics [Jonas 1994].

Analytically meaningful is, what is perceived and what is recognized in scene – and how this works. If the analysis of a situation or a problem is based only on the intuition of a „design priest" there is little chance to avoid the distortions that are produced by the three aspects of diachronous periphery, synchronous periphery and Blind Spot I have discussed before. In this sense, I claim that my model is enrichening the analysis of any design problem – at least as a heuristic.

Synthetically relevant is the aspect, how we can extend the limits of our structure determined limits of what we can imagine as a solution. This includes the aspect, that often the problem isn't described correct or useful. The level of the problem, on which it can be influenced efficiently may be a completely other than that which seem so evident. And the wide field of communication, of course, is a perfect paradigm for the necessity to think from the user to the designer – and not vice versa. The beloved *change-user-error* where the designer or programmer just claims that the user is to stupid for using the system is no solution. To reach a (sub-)culture by precise interventions or communications you have to think about the preferences and limitations of that culture in difference to other or our own culture.

This is true for economic interventions as well as for aesthetic or therapeutic interventions. In my sense any intervention is a design problem that shares the same premises. So *effectivity* and *efficiency* are fundamental for every intervention and we can easily translate them into the concepts I introduced in this talk. The aspect of effectivity is a binary difference, what means that an intervention has any result at all. This is at least very close to the concept of the Blind Spot, because there is a binary difference too, which also deals with the aspect that there is no effect at all. I think, they can be considered to be identical. The concept of efficiency however is not a binary one, but of continous differences. This is exactly what I have showed that the phenomena of periphery is. Every entity is more or less central or peripherical, if it is at all. And any entity has more or less efficient effect on any other, if it exists at all.

Presentational Space and Representational Space

Another distinction can be made (in biological and artificial systems) to create the conditions for mental test action. It is the difference between *presentational space* and *representational space*, which bring a complete new quality into any observing system.

The term *presentational space* defines the perceptual space [Grush 1999; Bartels 2002]. This is what any observer has, if it has any sensors at all. The *presentational space* is just that what we are able to perceive from the outer reality. It is the space of the sensory input.

Different from this the *representational space* is a pure mental space, which has no causal determination from outer reality. It can be described as a complete autonomous system of internal observation. Here we are not looking at the outer reality, but conscious looking into our memory. This cognitive space is complementary to the *presentational space*. Mental test action by using symbols

(or just say *thinking*) is located in the representational space, and this is the new quality that comes with this additional mental observing system.

Interactions between *presentational space* und *representational space* are of very interest, because the attention in one of them reduces the attention in the other one. *Second order observation* [von Förster 1999] in *representational space* (conscious reflection) reduces attention in the *presentational space* (perception) to the level of first order observation (pre-attentional syntactic field effects) [Jung-Beeman 2004]. Intuitively we think that we are processing them parallel all the time, but in fact we are not able to do this: We are much more alternating the two modes of processing.

As we double the possibilities when introducing the concepts of *presentational space* and *representational space* we should be aware that in each of them there are the former concepts of diachronous periphery, synchronous periphery and Blind Spot in both of the sub-spaces again. All the former discussion about the distortion of perception by the *observer-centered perspective* [sensu Piaget 1983] are to be considered in the mental space too.

The Basic Level of Reality and Mind

In this model the sensory space consists of two sub-spaces, which are deterministic closed against each other, but interfere in 2nd order observation. The sub-spaces can't exchange contents directly, altough the psychic system which observes both is irritated by both. And this way it is possible that they have indirectly effects on each other. As they are processed alternating by frequently switching from one mode to the other, the short time memory can have some residues or „hangovers", that influences the other mode. The meaning of elements of one sub-space is always to find in the other one. – this is another variant of the hermeneutic circle.

The human observer frequently switches from *presentational space* to *representational space*, back and so on. This seems to produce a self-stabilizing oscillation. The system of the observer is locally dynamic, but globally stable in this oscillation.

Finally, I would like to give a last example for the concept of synchonous periphery. Eleonor Rosch introduced the problem of what she called *basic level categories* in the late 70's [Rosch 1978]. Just remember where we startet with this talk: The fact, that every detail has details itself and so on. In other words, every entity can be seen as a structure which has sub-structures itself on the one hand, and is embedded in a super-structure on the other hand. We always look at a band-pass filtered part of a continuum of reality, which has a center of maximum sensitivity and a periphery of decreasing sensitivity. Eleonor Rosch showed that this is also true for cognitive categorizing. We learn this specific basic level categories first, answer with greater probalility in shorter reaction time with less errors, when using the basic level categories. Every sub-ordinate level and every super-ordinate level can be clearly described as a phenomenon of periphery while the basic level category itself is the equivalent of the centre.

If this sweeping from *presentational space* to *representational space* (and back) will always prefer the basic level to enter the sub-space, is not sure at the moment and should be tested empirically. But if the entry in a sub-space (what can be seen as a *semantic enclave* [sensu Kalkofen 1994]) finds place at the basic level,

interesting consequences were possible: The effort to think „straight forward" (to leave the *centered* [Piaget 1983] view of the basic level behind) could increase dramatically with the semiotic complexity in the periphery. Structurally determined constraints of the observing system would limit the distance which is possible to go from the entry at the basic level. In the case of humans this is the ability for Gestalt integration which seems to limited to about 3 seconds [Pöppel 2000]. This might explain why the „simple" ongoing of logical inference is such hard work – for us human thinkers at least.

Application perspectives

With this systemsemiotic model it seems possible to translate theories of different disciplines into an integrative terminology. I tried to show that it is possible to describe the design space with a small set of terms. This improves the accessability of an integrative model of the design space. The compact model of iterative concepts (*diachronous periphery*, *synchronous periphery* and *Blind Spot*) is easy to handle – and it is even extenable to further dimensions, if neccessary. You can describe and discriminate complete cultures with this approach.

This is fruitful for operational design of media and communication. What is called *style* is often just an artefact of one-sidedness. And this is of concern for designers as well as their clients. *Style* or *branding* should be the result of an explicit analysis of the space of possibilities and not just a random artefact. To do this analysis we have to access the design space in a logical way, which allows an economic analysis. A catalogue of possible features or differences would produce hundreds of features, where three simple constructs can do the same.

Additionally the approach enriches empirical design research by inducing actual research perspectives. Let me give you just one example, because it is impossible to discuss the possibilities here exhaustively. In perception you have the phenomenon of *habituation*. This means the effect, that the sensitivity for a feature decreases slowly while exposure (or when being exposed very often). You can transfer this concept of habituation into all the dimensions, I have introduced in my model. For example you habituate to your culture with the result that you perceive conflicts and contradictions in your own culture with less sensitivity than you see them in a unfamiliar culture. The same principle can be found in the observation of sexual preferences, perception of wealth or communication usage. Quantitative research with the introduced paradigm is relevant for various design disciplines.

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