

ANATOMY OF JUDGEMENT—AN ACCESS TO THE SCIENCE OF DESIGN

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Abstract: Usually designers think they create artifacts, but thoughtful designers create human-artifact-systems. The term artifact implies not only the fact that it is made BY but also, that it is made FOR men. Even a dog bowl is made to please men, because man's best friend will eat its food from a newspaper as well. Such a system consists of the two subsystems human and artifact. The analysis of the elements (e.g. color, shape, light) that artifacts are made of, has virtually been completed and quantified during the last centuries, so that now these elements are available in modeling software and thus help us to synthesize past and future design. How much do we know about humans, the other subsystem? A system cannot be conceived by regarding only one of its subsystems.

We get in touch with design by using, recognizing and appreciating it. We buy it, deal with it, talk about it and so on. All of our involvement with design could be reduced to one single cognitive element, which is presupposed to it, the judgement. We first have to judge (e.g. upon some options), before we decide about something. Every human action requires a decision, anyway if conscious, pre- or unconscious. Our statements about design require judgements and unspoken thoughts and attitudes are based upon judgements too. Even visual perception is created on judgements, because we do not only see something, but we see it AS something, we recognize what it is. The process of judging obeys a simple formula: judgement = perception + value.

Every perception is instantly attached with a tag. When we see a face there are several variables to be filled in with values, like age, sex, attractiveness, race, emotion and so on. Those inserted values could be e.g. "male", "old", "European", "sad" or many others. This is the basic procedure, which is accomplished when we perceive, speak, think, argue, act or decide. So if we understand the process of judging, we can shed light on the cognitive activities that precede the overt answers of users to design. The more we learn about judgements, the more we can control the users responses to design. A designer could anticipate how his or her clients would appreciate the variants he or she conceptualized. The very instant of judging could be observed with neurocognitive techniques like an electroencephalogram (EEG) or electromyogram (EMG). To tile an anatomy of judgement could be developed by these methods.

EMG not only indicates, if there is an emotional involvement of the beholder or not, it also diagnoses, if it is negative or positive. This approach would add a scientific background to the long-lasting debate on emotional design. EEG is a reliable method to sequence seemingly synchronously appearing parts of our instantaneous judgments, like attributes of design, and thus identifies them as entities. EEG also detects semantic attributes of design more objective and valid

than up to now. The discussion about semiotics in design could be revived with new scientific arguments, which may lead to more target-oriented implementations.

Key words: Judgement, Usability, Neurophysiology, Design Thinking

1. Design and cognitive science

Beyond the usual classification in product-, graphic- and media design, it is split into a multitude of further, sometimes very special spheres of activity. Some of these disciplines have developed to be subjects of design curricula, are represented on chairs in colleges of design, invite to their own design awards or at least are requested in employment ads. The results of those fields, the projects, are extraordinary manifold, and so are the appropriate methods and theories, that emerged and still emerge around those fields. Regarding all the differentiation, fuzziness and complexity, designs have still something in common. There is for example the fact that design is still made BY persons and FOR persons. Even if in any utopian future design was made by machines, the target group would still be the human user. This orientation towards humans results into the central claim to consequently consider human science to build theories of design, e.g. medicine, anthropology, sociology and psychology.

1.1 Design as communication

It makes sense to regard design as communication. The elements that a designed object is composed of, and the co- and interaction of these elements hold and transfer meaning and sense. Design elements are signifiers. Thus even industrial and product design are in a certain respect very similar to graphic or communication design. Spacy design or lots of functions and information are not useful, when they cannot easily be deciphered. The success in understanding design depends also on hints provided by the perceivable elements of the design. Designers are encoding information into the design to help understanding or using it, the user again reads them out. This should preferably happen in a “language” that users could understand. At this point design reveals its intrinsic problem: users and products are equally numerous and at the same time very differentiated. Products again could transport many single elements or functions and thus information bits. But also individual users respond highly diverse, depending of their mental and physical condition, experience or the situation they encounter the design. These facts make a generalization of the act of communicating via design very difficult. In fact it is chaos—yet.

1.2 Scientific approaches

Terms like product language or semiotics were introduced to tackle these difficulties with appropriate theories or fragments of theories. But there was no big effect on design practice yet. Also those approaches not regarding single individuals but groups, e.g. marketing or sociological methods, have proven to be of limited usefulness. They can, just like market analysts, only perform very imprecise predictions, but sometimes explain quite well ex post, why a paper or sales rose or fell. Tools like these may improve sales but not quality of design. Another approach hardly capable for the purposes of design theory is art history, which only reviews design issues in a rear view mirror. But design is a discipline of planning and strategy and needs a basic theory that anticipates

future scenarios, making it possible to deduce and explain actions and decisions of designers. A simple extrapolation of the past would not be enough, but history of arts regards past and present events at best. Of course no artist would develop his or her future opus following the present theories of art history. Designers should have a basic theory, they can work with adequately and target-oriented, just like chemists have the periodic table of the elements, architects and engineers have physics and mathematics, or physicians have anatomy and cytology. Designers are in a different way creative than artist are, although artistic aspects certainly play a role in design. The most significant difference is, that design is always purposeful, but in today's arts this particular attribute would appear rather suspect.

1.3 Cognitive psychology as fundamental science of design

The central position of human in the design process (mentioned above) is an adequate starting point to think about a constitutive general design theory. Thus we enter the domain of psychology, which deals with the human as individual. Those aspects of psychology relevant for design, like information processing, valuating, using and experiencing design are touched in cognitive psychology. It analyzes what happens when we speak, think, remember, act, learn, decide and more. All of the mentioned processes rely on a fundamental process, and that is judging.

2. Judgments

Terms like judgement or judging are used in manifold ways. They can refer to issues like a sentence of a court, a description of an appearance, a categorization or simple perception, a short impression or a grown attitude. It does not make sense to distinguish between complex cognitive judgements and instantaneous sensual judgements, because the continuum between those two poles is absolutely smooth and without any fissures. Each judgement depends on several sources of influence and at the same time other concepts like decision making, language, action and attitude depend on judgements (fig. 1). Each of them again is important for design. Judgement could be described as the smallest cognitive unit.

2.1 Categorization and judgement

A categorization is a special case of a judgment, where possible answers are given. In perception experiments tasks often force decisions. Known examples are to distinguish gender of faces, semantic decisions, e.g. if a stimulus is an animal or not or if a vessel is a cup or a mug. Judgements like these can lead to a response like a keystroke or a verbal answer. But often judgements are performed without any apparent reaction. When we move through a crowd of people, we categorize and judge permanently but invisibly gender, ethnic group, attractiveness, age, social state and emotional expression of faces.

2.2 Decision and judgement

Decisions are required to perform action, like speaking, clicking a link in the web, buying a car or just switching the gear. Decisions should by no means be equated with judgements, the former only rely on the latter. Judgements are necessary conditions for decisions. The given options to decide upon are evaluated separately and then compared. Decisions can be performed consciously, preconsciously or unconsciously (automated), they can emerge fast or slow. An action may or may not follow.

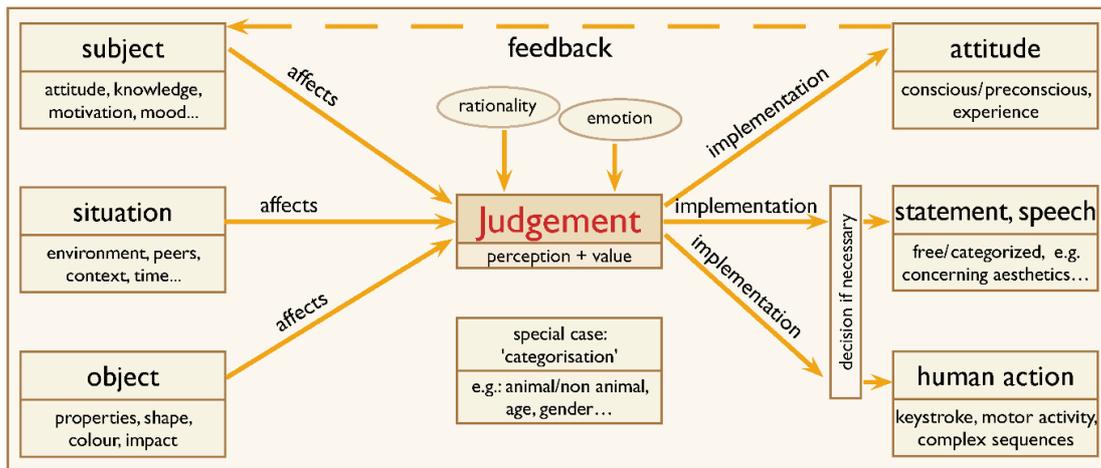


Figure 1: Judgements, input and output

2.3 Perception + value = judgement

A Judgement is generated, when a stimulus is combined with a value. The value comes from the brain of the judging person, where experiences are processed and made retrievable since the early childhood. Value should be interpreted here in terms of a formalized concept. If a judging person has to recognize a face as female or male, an appropriate value is inserted into the variable for gender. Perception + value = judgement. Performed judgements could be saved as value again and thus could be a component for new judgements following new impressions. The judgement emerges exactly in the moment when the external world touches the internal world. This instant is observable by neurophysiological methods (3.1—3.4 in this paper).

2.4 Judgements are variable

The many influences affecting judgements can be classified into three sources. The content of a judgement depends on the judging person, the situation and the object to be judged upon (fig 1). Different people also judge differently, depending on the experiences they made, their individual values. Also the situation affects judgements, the social context, the time provided to judge or other environmental factors. Finally also the object we judge upon has an influence on our judgments. “Varying appearances in a way, that clients JUDGE in a desired way” could be the definition of the profession of a designer.

2.5 Thinking and judgement

Attitudes and knowledge are older judgements, transferred into the repertoire of values as an individual constellation. As values they have influence on the content of newer judgements. Thus, it is necessary: judgement (new) = perception + judgement (old). The phrase “judgement” (old) is continuously replaceable by “perception + value”, “value” again is replaced by judgement (old, older, even older...). This process is iterative, recursive and is retraceable to the first perception after (some say before) birth. The processes of attachment of values and the internal request for variables are supposed to be innate. Thinking takes place by operating with older judgements, it again generates judgements (syllogistically), even without an actual perception.

2.6 Implementation of judgements

Judgements themselves are not easy to identify. They could be detected indirectly in action, language, thoughts, memories and other implementations (fig. 1). Even the assignment of a term to an idea—and thus semantics—is only possible as a consequence of judging. In some situations it is even impossible to put a present judgement into words, e.g. when experiencing certain stimuli of taste (as in a wine or whisky tasting or nosing) or when remembering a scent of the past. So some judgements happen isolatedly without being implemented.

2.7 Anatomy of judgements

Obviously judgements are ubiquitous, quasi a basic unit of our cognitive processing (like a cell or an atom). They underlie a currently inestimable number of internal and external influences. Emotional or rational mechanisms are imaginable, or maybe also situational components. Which factors are relevant in detail and how they compete or combine in the process of judging has to be explored systematically.

3. Observing judgements

Exciting about judgements is, that a set of physiological and neurophysiological procedures permits to gain knowledge about them. In doing so, unlike in questionnaires, not statements and attitudes are considered, but involuntary responses of the participants are evaluated.

3.1 Eye-tracking—the “where”-question

Eye-tracking experiments often use objects of comparison as stimuli. For example two cars are shown and it is asked for price, security or other properties (Hammer, 1992) [1]. The patterns of eye movement differ dependent on the question presented. They indicate those details of the stimuli (here: cars), where visual cues are expected to inform the viewer about price or security. For designers, this is valuable information about which details are to be manipulated or optimized to transmit the messages respectively. The participants have judged implicitly and shown their judgement via eye movements.

3.2 Electroencephalogram (EEG)—semantics revealed

Brain voltage emerges continuously. It is hardly possible to gain meaningful information from the multitude of values measured. A good insight is provided by event related potentials (ERP), systematically recordable within the first second after an event, like the presentation of a stimulus (Rugg & Coles, 1995) [4]. In this way causality connects stimuli and certain patterns of brain voltage clearly as cause and effect. Depending on the experimental design, distances between semantic issues (pictures, language) are made comparable (Kutas & Hillyard, 1980; Nigam et. al. 1992) [2], [3], or seemingly simultaneously emerging cognitive performances (syntax, phonetics and semantics in speech production) are sequenceable. So these methods are a key to design semantics.

3.3 Electromyogram (EMG)—emotion revealed

The emotional involvement of subjects is recordable by measuring face muscle activities. The responses of the muscles involuntarily emerge even in absolutely relaxed looking faces. Sensors on certain spots at the forehead

and the cheek indicate existence and modality of emotions during systematically changing stimuli. Results are by far more reliable than questionnaires could ever be, as the responses are involuntary.

3.4 Functional magnetic resonance imaging (fMRI)—mapping the brain

Furthermore, that method should be mentioned, which became so very popular with its many colored images during the last years. It provides a very spectacular, three-dimensional view into the brain and its activities. The spatial resolution is very high, the temporal resolution in contrast is low. So the procedure delivers mainly brain mapping, but only little insight to complex, functional processes. EEG records 1000 and more entries each second, fMRI only a few. It detects the change of oxygen or glucose concentration in blood, which only alters around once per second. New approaches combining fMRI with EEG and attention psychology seem to point to future direction.

4. Conclusion: Judgement in design

Users and beholders of design produce judgements in the above sense permanently. They help to appreciate design, to control acting and thus to deal with design. Until now evaluation of design was very case oriented (use cases) and therefore hardly or even non-transferable to other or new design processes. If the gained knowledge was generalized to make it fit for other cases, it was too fuzzy and abstract to be helpful. Each design had more or less its own theory.

4.1 Benefits of judgement analysis

To sum it up, at least five properties of judgements should be listed. 1) Judgements are very central in human cognition. Language, attitude and action are built on them, and they are all important for design. 2) Judgements are elementary units, like atoms of cognition. To regard them may be more useful than elementarizing the brain into trillions of neurons and dendrites. 3) The two big cultures humanities and natural science are not only bridged but they even touch directly in a contact point. Judgement is an analytical concept of humanities, the measurement of them a scientific method. 4) As judgements combine perception and value, they represent the exciting moment when our internal world touches the external world. This moment could be observed and measured. 5) Altering judgements of users via design could be a definition of the designer's profession.

4.2 Elements of design

It is inherited by the academies of arts, to analyze the instruments and elements of composition. Light, proportions, colour, shape and so on were examined by artistic and technical analysis. The artistic analysis came along with the process of pre-modernism and modernism and their doctrines, schools and movements e.g. impressionism, cubism and other -isms. They, and not scientists, pioneered the implementation into practice. By now also the technical analysis is successful, proven by the fact, that the elements of composition are standardized in a way, that allows software applications to have access to them and to synthesize virtual worlds.

4.3 Human and artifact

It is not enough to know about all the practical and intellectual tools of design and to be able to express oneself. Furthermore knowledge about mechanisms of reception is important. Design does not take place isolatedly, but

it rather addresses the human, who uses it. We do not only deal with the production of artifacts but with human-artifact-systems (fig. 2), analogue to the 1930s term human-machine-system. But if we think it was enough to analyze just one of both subsystems, the artifact, we will finally understand none of them. There is a lot of catching up to do concerning human as a subsystem in this constellation. Systematical, electrophysiological inquiries of judgements as such and associated with design could provide a substantial contribution.

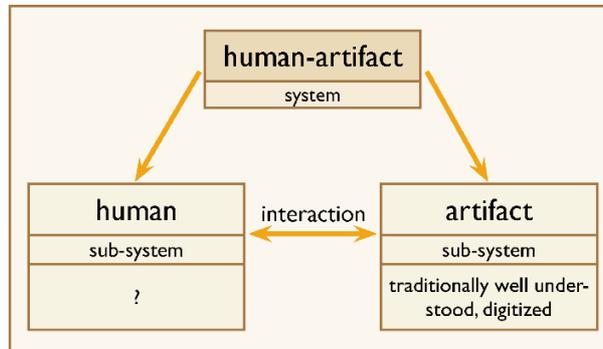


Figure 2: human-artifact system and two sub-systems

5. Citations

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