

## An Introduction to Performative Science

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Performative Science might be regarded as a cross-border concept. At any rate, it is far from being intended to pull down the border. To the contrary, I started to work on the concept in order to boost the complementary role of art with respect to science. The recent tendency of a strong convergence (in the sense of leveling) of art and science and also of art and marketing is scaring and addressed in the following critique.

I think it is not too far-fetched to roughly assign the rise of convergence of art and science to the mid 20th century advent of cybernetics and/or informatics. Needless to say that particularly the computer revolutionized not only sciences but also the arts. More recently, the exponential increase of using the keyword "art&science" flow into an almost vertical slope and may now easily be called a buzzword.



ExplosionBot. The image searching interface adapts to the previous searching behaviour and finds the desired category. The user interacts with the eye-tracking device as well as the screen with the array of images can be seen. In the course of the searching process, the array of images is regularly replaced by pictures out of the most desired category.

In my awareness, and I think this is really a remarkable point, in recent years the notion of "art-science" started to emancipate itself from being almost reduced to the usage of IT in the arts, and in particular to cybernetic technologies. Scientific topics are now (again) following eminent artists before the art-science hype like Marcel Duchamp or Shusaku Arakawa) addressed by other means than virtual realities in a technological sense. Art can throw a performative glance onto an essentially stationary approach in the sciences. This is the constitutive element of performative science. Of course there is a large fraction of artists that use technology as a "creative tool" and as a means to create and to explore virtual realities. These areas of "art-technology" should be, but are not always, well distinguished from the area called "art-science." This article contains a critical discussion of the observed "Cybernetization" of culture but at the same time tries to push an emancipated form of "art-science."

Trained as a physicist, I moved in 1999 to the Center for Art and Media in order to launch and to run the Institute for Basic Research [1] until end of 2005. Therefore, my appreciation of "art-science" may be rather strongly influenced by a specific art community (artists as well as theoreticians and curators) that feels very attracted by scientific ideas. Frankly speaking, I was rather surprised about the way science was preferred with respect to art. Art has been diagnosed to get stuck in a representational crisis. As a member of some "art-science" networks and societies and observer of many other related communities I well recognize a booming membership in those networks (see, e.g., [2, 3]) which means that there is a general trend towards addressing scientific topics for manifold reasons. In general, I highly welcome this interest of the cultures in each other. However, an approach only for reasons to be trendy might endanger the progressive interface discipline.

At the beginning of my personal rudimentary engagement with the arts, the endophysics perspective [4] was the driving force to do so. An essential idea of endophysics is to use simulations as a means to

ask questions about a world that can be seen from an external stance in order to eventually find solutions for questions about the "real" world in which we are endo-observers. Whether or not artists in the so called fields of "new media art" explicitly address endophysics problems is not particularly relevant for finding endo-aesthetics in many of their works [5]. In a sense, artists have been endo-physicists all the time. Only that in the case of "new media art" the used tools converged with respect to science.

Starting out from an endophysics perspective, it is the agenda of this article to revive an Heideggerian view of the difference of art and science. An essential synopsis can be found in Oliver Jahnke's account [6] of Heidegger's fundamental ontology [7], which reads as follows: Science and Technology bear a high risk for a tendency of Verdinglichung (reification) whereas the arts have a tendency to be capable to twist out from Verdinglichung. Axel Hommett recently gave a clear introduction to the concept of Verdinglichung [8] originally introduced by Georg Lukács and poorly translated into reification, which is why I prefer to stick with the original German noun. Hommett's synopsis of moral principles; rather, it is the failure of those human practices and attitudes that constitute the responsibility of our way of being. In my usage, Verdinglichung can be paraphrased as "a suspension from ethical decisions."

To give a first clue to the meaning of "performative" as it is used in "performative science" it may be rephrased in an allegoric way as: Endowing the algorithms with a soul. It does, however, not exclusively refer to the scientific practices. Beyond the "agents causality" or, as A. Pickering calls it, the "manage of practice" [9], the main focus lies on finding a way to model complex phenomena without stripping away those features that may rather be called "essentials" than "essentials." The traditional scientific method captures only the "essentials" which are, in a nutshell, all features that can be measured and stored in a database. This explains the sciences' power to describe

dynamics with invariant features but at the same time their shortcomings in describing the animate world. It may well be that performative science is at the edge of vitalism. With this reproach, however, performative science is in good company with process philosophers like H. Bergson [10], A.N. Whitehead [11], M. Heidegger [7] and many others.

Performative science can be seen as an endophysics variant. There is a major difference though. Endophysics contains the observer but reduces her or him to intellectual faculties. It is a rationalistic approach. Performative science accounts for the fact that the observer has a body. It is an interface theory far from the Cartesian or the Heisenbergian Cut. It comes much closer to the Heideggerian interface: the ontological difference. Being physically involved is the crucial point and holds for the observer as well as for that what is modelled.

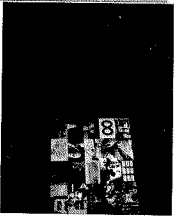
In recent years, the ROI of general system theory has been expanded to the proximity of the interface. G. Birkhoff introduced an aesthetic measure in the 1930ies [12] which evolved on the fertile soil of cybernetics into M. Bense's information aesthetics in the 1960ies [13]. State of the art is to capture aesthetics as a self-organizing phenomenon from a synergetic point of view [14, 15]. Even the observation that art counteracts to each attempt of being defined has been described by means of kinds of self-modifying synergetic model [15]. Cybernetics and synergetics want to manage the impossible. Modeling systems that account for creativity, innovation, novelty and so forth. It moved into the focus of my current investigations to scrutinize the vanishing difference between artificial intelligence and human qualities like creativity.

#### Bayesian inference pars pro toto for Verdinglichung

The mathematical description of many decision making processes is based on the "Bayesian inference principle." The principle was named after the British clergyman Reverend Thomas Bayes, who introduced the notion of conditional probabilities [16]. The crucial point of this principle is that it is based upon the use of subjective probabilities, i.e., degrees of belief. This provides a link to hermeneutics, as is argued quite frequently [17, 18, 19]. Methods like the Bayesian inference principle are nowadays constitutive elements of information technologies. These are used in many fields of knowledge organization, as well as in all fields that are involved in the optimization of operational directives. For better or for worse, such methods rule the internet and other parts of the "information society."

The Bayesian inference principle,  $O_{\text{operational}} = LH^{\text{temporal}}$  which maps an a priori knowledge onto an a posteriori knowledge can be used in an iterative way. The entities  $o$  (odds) are the degrees of belief in hypotheses expressed as chances. The factor LH is the "likelihood quotient." It results from the observation, or is derived from an experiment or a test, and is determined by experimental conditions which are expressed as characteristic parameters, such as sensitivity and specificity. In complex cases of mutually conditioning determinants, this seemingly trivial formula can become quite complicated through the accumulation of nested conditional probabilities. At least in principle, the validity of a certain hypothesis can be expressed as nested conditional probabilities that account for the validity of concomitant hypotheses (i.e., context). Usually, one starts the procedure with an initial value for  $O_{\text{operational}}$ , given according to the available pre-information. It goes without saying that the more data from the prehistory of experiments, observations, and corresponding decisions are integrated, the more robust is the result. This, however, is virtually impossible without the aid of digital databases along with appropriate software tools.

The knowledge related to the whole and the newly



The ZKM media museum version of EyeVisionBot. The pictures are taken from [www.mediaartnet.de](http://www.mediaartnet.de) in cooperation with the corresponding mediaart documentary project.

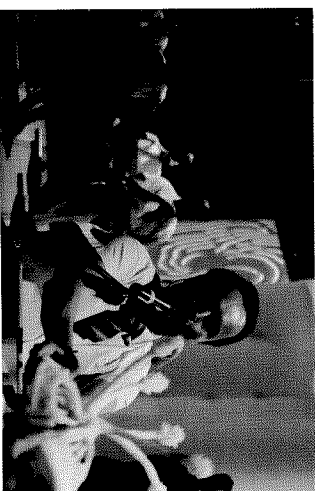
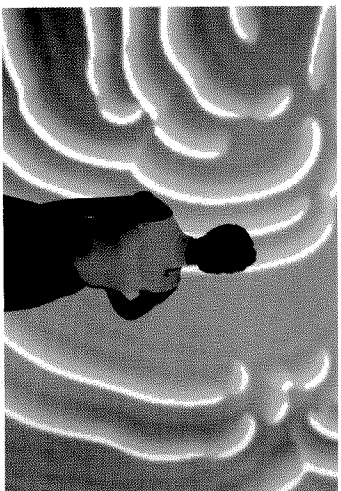
The gazing times of the users per image are evaluated with EyeVisionBot. The program makes the preferred scenes by analysing and comparing the structural information and metadata of the pictures. The following series of images clearly shows the preferred category in terms of structural resemblance.



Liquid Perception, Scene from the opera "Enstern on the Beach" staged in the Parochialkirche in Berlin 2005. Actors in front of the reactive simulation of a neural network.

Liquid Perception, Scene from the opera "Enstern on the Beach" staged in the Parochialkirche in Berlin 2005. An actor in front of the reactive simulation of a neural network.

Liquid Perception, Scene from the opera "Enstern on the Beach" staged in the Parochialkirche in Berlin 2005. The production directed by Bernhard Schnieder addressed currently controversially debated scientific topics which may be paraphrased as "designing truth". Liquid Perception can be seen in the background.



acquired knowledge from individual cases mutually influence each other in a manner that is similar to the hermeneutic circle. For example, T. Winograd and F. Flores [17], as well as J.C. Mallory, R. Hurwitz and G. Duffy [18], point to the relationship between Bayesian-like methods with hermeneutics. It should be emphasized, however, that G. Gadamer above all regarded a methodological application of hermeneutics as insufficient. In other words, hermeneutics cannot simply be reduced to a method. In fact, a strict application of the Bayesian principle leads to a typical epistemological self-reference, which will be elaborated upon below. Furthermore, it is questionable whether all relevant determining factors can ever be apprehended with the use of such a method. Therefore, despite the fact that the same updating process is described in a good approximation by the Bayesian inference principle, it remains questionable whether the latter is a proper model for the hermeneutic circle. The difference lies in the retrospective nature of the Bayesian procedure versus the processual nature of the hermeneutic circle.

In practice, the experience of the individual is combined with that of the community, which cannot be strictly separated anyway. In this context, a brief remark on the Bayesian concept from a 35-year old textbook on Statistics in Experimental Physics is quite illuminating [20]:

"The Bayesian takes the odds to mean the degree of belief in a hypothesis, and he attempts to express this degree of belief numerically. He takes Bayes' theorem to be valid also for hypotheses. [...] The anti-Bayesian criticism is that all physicists will have different degrees of belief, and so the conclusion will be subjective. The Bayesian defence is that  $O_{p|e}$  really should be written  $O_{p|e}(h)$ , where  $h$  is the set of all hypotheses and all previous knowledge, and that if all physicists would pool their previous knowledge, they should be able to agree on a distribution  $O_{p|e}$ ."

Nowadays, this thought-experiment turned into reality.

The individual decision making criterion derived from observations, measurements, test results and so forth, is (almost always unnoticed) compared with and adapted to resembling previous results and related decisions. In order to provide an optimal foundation for decisions, Artificial intelligent methods that are based on the Bayesian inference principle have recently become omnipresent. Day by day, a Bayesian learning algorithm filters spam from our mailbox, and likewise, the MS Office Assistant sometimes irritates us when it tries to anticipate our next action. Individual preferences adaptively alter the algorithm. And everything is stored into the database.

Data mining, knowledge organization, and any form of surveillance are almost inconceivable without the Bayesian inference principle. The February 2000 issue of the new media magazine "Wired" reported on the surveillance and data mining software package "Autonomy", and featured its author Michael Lynch [21]. The article does not report the fact that applications of Autonomy in video surveillance systems (such as in London's underground) have been heavily criticized elsewhere. In the latter applications the software "anticipates" future crimes so that the potential criminal can be pre-emptively arrested.

Why is the Bayesian inference principle so successful and renowned? In the cognitive sciences, researchers sometimes speak of a "statistical homunculus" when referring to the idea that the decision-making process in the human brain is identical, or at least bears close resemblance to the iterative Bayesian algorithm [22]. Artificial intelligence endowed with Bayesian learning seems to be a "natural" implementation of intelligence. In this framework, aesthetics can also be transferred to a "rational" basis. One has to scan the brain activity in order to "objectively" put an aesthetic decision onto a deterministic functional basis. The philosophers Boven and Hartmann recently introduced the concept of "Bayesian epistemology" [23], confirming that it is indeed an important and prevalent approach. It also shows that the method approximates cognitive processes well, particularly when pertaining to decision

making, and even to a certain extent, knowledge acquisition. From a positivistic perspective, one may argue that the overwhelming success of the Bayesian method serves as evidence for the "homunculus".

Picture a physician taking an x-ray image of a patient in order to get indications for a certain suspected disease. She interprets the x-ray image and adapts the further treatment accordingly. With respect to his or her findings, one can assign a certain sensitivity and specificity to the doctor. This leads to a paradoxical situation, wherein the physician tries to act in accordance with the statisticians' recommendations, and to scrutinize the outcome on the basis of prediction values estimated with the aid of the Bayesian formula. I speculate that, even in "objective" tests, i.e., those tests that rely on the results of measurement devices, the doctor sees her- or himself as somehow "entangled" with the device. Thus, even in such cases, the doctor may regard the statisticians' recommendations as ridiculous to a certain extent. Things are fairly different when, on the one hand, they are described from an external position or, on the other, when one is physically involved. This paradox is amplified in the face of "evidence-based ethics", as the demand for a computerized (objectified) decision is sometimes called.

It is even more amplified in the face of the "democratization of society" through the internet. I speculate that the observed cybernetic irony is correlated with the designed structure of cyberspace, where design here means a well-posed factious freedom that appears as chance or contingency.

Within the given context, *Verdinglichung* can be linked to the externalization of the decision making process, particularly in cases that definitely do not involve moral lapses, but rather attempt to increase objectivity or seek the democratization of knowledge handling. A typical example from medicine is an image database of radiological shots [24]. Pictures entered into the database are subject to a standardizing procedure and are categorized according to structural resemblances and related findings and decisions. Pattern recognizing algorithms compare newly

submitted images with those from the archive, search for structurally resembling recordings, and supply recommendations for the further line of action that joins the majority of past decisions. A critical attitude may be hard to maintain under the given circumstances. Doctors who decided this ... also decided that ..."

Even worse, if the stark requests of some statisticians are satisfied, then visual feedback will be circumvented more and more in the future, and x-ray examinations will be automated. A long-term collection of radiological images, along with their corresponding decisions, may have a similar impact as a subjectively "well-adapted" spam filter, which eventually may be entrusted to allow for fully automated decision making. Beyond that, it may be convenient to abdicate responsibility and refer to the "objective" decision made by a software agent. This is not objectionable from a moral point of view. To follow Heidegger, humans are withdrawn from *Sorge* (care) in this context, i.e., from being existentially involved in the decision-making process.

**Convergence of art, science and marketing**

Please note that the Bayesian principle is only one ingredient of a cybernetic design of society. It comes along with network theories (based on graph theory) and a system theoretical approach to the evolution of culture like, e.g., memetics. Memes, i.e., the "cultural genes", propagated by means of an epidemic-like dynamics (propagated to the notion of "viral marketing" or, more general, to "guerrilla marketing", "Word-of-mouth", knowledge diffusion and the like is subject to anticipating models (see for example [25] which contains a summary). These models and algorithmic techniques also provide a powerful basis for modeling "creativity" (factiously) and to let F. Flores and S. Beer's vision of an "operations room" in Chile's CyberSyn project [26] come true with some decades delay. Viral marketing with the aid of cybernetics is close to perfectly design social reality.

The weird point about the models of creativity is that

the arts themselves pay homage to those models in a scaring way. Artists are in search for robots that replace them as artists [27]. This may well be an artistic rhetoric only, part of childishly scrutinizing the limits. Unfortunately, however, they thereby become members of an "evidence-based" society, a society of "nodding-through" people. To rephrase it even bolder: Art becomes part of a "prejudice-affirming" machinery under the delusion of "democratization". A further example is given through "Guerrilla art" [28]. The applied "viral" dynamics of memes in the arts is indistinguishable from the context of cultural evolution through viral marketing [29]. In fact, viral marketing often claims to contribute to culture in an artistic way and characterizes itself as acting "honestly". The "honest" thing thereby is, that the public is supplied with "knowledge" that it asks for. It is in this sense a "wishing machine." And since this "knowledge" is voluntarily spread over the biosphere, it can be called "honest" for a further reason, namely in that it pretends not to be advertising or propaganda or something like this. To spread not only our genes but also our memes in the best available way, isn't this what we did all the time? Yes, but the cybernetic tools allow for an efficiency that leaves almost no freedom of choice because the choice is handed on a plate. Contingency is pretended. Moreover, the decisions behind the evaluation of the optimal nodes in the network of bloggers in order to optimize the diffusion of memes is largely de-personalized. Such dynamics suppress contingency. The marked space of prejudices is mapped onto itself.

The viral marketing specialists are educated as "communication designer" at the academies for art and design. The monitoring system "Blogvuz" that captures meme diffusion in the biosphere explicitly builds on or has at least been inspired by several works of art as described in the thesis [25]. Renowned and eminent artist who are brilliant engineers, too, forge on a "matrix" that bears the fruits of cybernetic irony: a paradise for the Eloi [30].

The eminent artist collective Übermorgen recently completed a "project" called Amazon Noir [31] in

which they allegedly hacked the online bookseller Amazon with an algorithm that allowed for a quick completion of excerpts of books ending in complete versions. However, as the story continues, they sold the software to Amazon along with a contract not to publish the algorithm. The interview (available at [31]) with Übermorgen by Ritchie Petauer reads like an excerpt from "The Matrix." The interview contains an explanation of an appealing concept, which Übermorgen calls "reestyle basic research" and then

culminates in a question by the interviewer, whether such kind of activism would be the "next level" of media hacking. Reports on activities that never happened? Übermorgen agreed, that they already experimented with it. They affirm however, that this was not the case with Amazon Noir. Anyhow, the observers might well conclude, that it was nothing than a guerrilla marketing campaign. Note, this is only the tip of the iceberg of a global disappearance of conceptual distinguishability. I nevertheless hope that the Amazon Noir project will be perceived from a meta perspective, i.e., as a critique of the cybernetic irony. The weblogs discuss the pros & cons of the hack with respect to copyright and things like this and whether art is free to do everything. They mostly do not even recognize that the "next level" has already been reached. The cyber-presentation of Amazon Noir meets the requirements of the Cyber-irony.

The system-theoretical analysis of society leads to similar self-referential paradoxes as described above, and usually ends in an infinite number of hierarchical levels of observations or in cybernetics of the *n*th order. In our daily activities, we are usually not amenable to such a paradox. We resolve the deadlock of (metaphysical) self-referentiality because we are endowed with a non-propositionally composed "performative" logic. We are unable to account for the ideal of the Enlightenment and to act in a prejudice-free manner all the time, but rather act historically AVD processually. In recent publications, I suggested to call the methodological field that deals with such performative methods in science an "operational hermeneutics" [19]. It is a process-based approach

that temporarily uses predictions through retrospective models, but is open for correctives and normative interventions. Additionally, and most important, the language (i.e., logic) used in operational hermeneutics is a "physical language" that is primarily aimed at the senses. Operational hermeneutics aims at complementing the natural sciences' truncated way of regarding first principles with (processual) pre-understanding rather than (historical, i.e., memorized) pre-knowledge. The optimization of decision making processes through IT, which is based on neuronal pre-knowledge, leads to a *Verdinglichung* of "metaphysical dimension", an expression used by O. Jahraus in a similar context [6]. Strict historicism either leads to self-referentiality or to *Verdinglichung* when it is externalized through artificial intelligent systems. What in fact is optimized in the later case is the best of what has been memorized, which is, in essence, a pure "prejudice affirmation."

Human beings do not constitute an ergodic system. Most of the so-called context-sensitive IT-procedures, however, start at least implicitly with assumption of ergodicity. Complicated adaptive methods based on "Bayesian learning" anticipate the wishes of users of digital data space from their previous behaviours. The ergodicity assumption – for example, the assumption that *n*-lines successively throwing a single die shows the same probabilistic behaviour as an ensemble of *n* dice thrown at once – lead to the well-known successful model used, for example, by the online bookseller Amazon: "Customers who bought this book also bought ...". This notation works even without expensive adaptive algorithms, because, amazingly enough, in many cases human behaviour proves to be ergodic in good approximation.

It is worth mentioning in passing that the renowned system theoretician Ilya Prigogine has been heavily blamed for his critique of ergodicity. Prigogine's attempt of "temporalization of time" in order to escape from the authority of a retrospective pervasion of enrolling led him to be affronted as postmodern intellectual impostor [32]. Prigogine counts to those comparatively

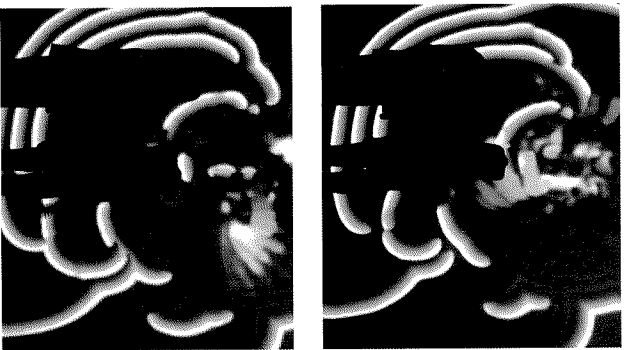
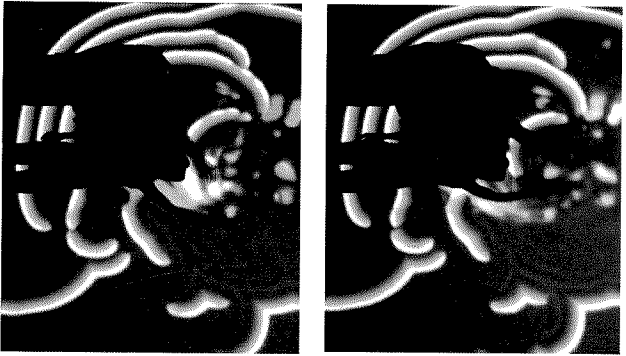
few system theoreticians who recognized the straightjacket of homogeneity given time that reduces all events to happen in time instead of regarding events as enrolling, i.e., as Being. It seems worth mentioning that scientists from the fields of cultural studies or related areas often use the term "nonlinear" when they refer to the non-homogeneously given time or to a time that is constituted through the events, i.e., synonymous for contingent. Nonlinear dynamics does normally not account for this "cultural nonlinearity". However, in Prigogine's approach it does in a way. Chaotic or nonlinear dynamics was indeed a vehicle for him to let nonlinear temporally emerge. From the "hard discipline" side, I. Prigogine and O.E. Rossler certainly count to most important promoters of an interface theory. Nevertheless, in my opinion Prigogine was condemned to failure from the beginning because the after all got lost on the semantic (the representational) side of capturing Dasein. Performative science aims at adopting the nonlinearity found in the performative logic of art.

#### The arts as blow-off valve for Verdinglichung

The Bayesian inference principle is an almost perfect method when applied to recorded data. There is no doubt that it manages pre-knowledge perfectly. There is an important but widely overlooked difference, however, between pre-knowledge and pre-understanding in Heidegger's terms. Pre-understanding is ahead of any anticipating method that relies on pre-knowledge only. Many philosophers do not clearly differentiate between these two concepts. The more perfect the pre-knowledge-based system is, the more we tend to be pleased by the result and stop to reflect on it: this is where *Verdinglichung* sets in.

The ergodic assumption behind statistics is why probabilities do not supply an essentially new

A series of snapshots taken from "Enstein on the Beach" staged in the Parochialkirche Berlin in 2005. The spectators aimed at synchronization of their speech with the musical rhythm and the dynamics of pattern formation in Liquid Perception.



characteristic compared to determinism. It is a widespread error, in my opinion, to believe that probabilities can support the philosophical concept of contingency. The processes can neither be captured deterministically (in the sense of differential equations) nor statistically, which is in this respect not a new concept. Both descriptions are retrospective ones. Actually, this is why I regard the Bayesian inference principle as a good formalized approximation to a dialectic principle but not to the hermeneutic circle.

In a successful case, the externalization of cognitive processes leads to a reduction of humans to a "noodling-through society". What I criticize here is the tendency for IT to circumvent the sensory interference in order to allegedly objectively the decision-making process. The withdrawal of sensory feedback is accompanied by *Verdinglichung*. The balance between the usage of "methods" (operational directives) and the "non-methodical" hermeneutic process of being physically involved is what I call "operational hermeneutics". "Operational hermeneutics" ensures the preservation of responsible human interaction.

The challenge of ethics is to adapt normative guidelines in conflict situations and suspected errors. In this context, *Verdinglichung* excludes errors in that responsibility is shifted to an "infallible" algorithm. Existing norms are thus maintained. Therefore, the discussion of *Verdinglichung* through the use of IT is located somewhere between ethics and critical theory. The usage of anticipating machines ("wishing machines") is not immoral per se. However, even in the area of information engineering, the "Midas touch problem" is frequently discussed. This name comes from King Midas in Greek mythology who asked the gods to turn everything he touched into gold. The gods' fulfilment of his desire led to life-threatening starvation. To relate this back to *Verdinglichung* and the role of art, I advocate for a strengthening of that role of art that has been favoured by Heidegger. In a somewhat provocative way I even claim that in this respect mankind can learn from the Catholic Church. Taking into account the tendency toward infallible

algorithms, the papal infallibility gets a human touch. It shows on the one hand, that man obviously has all the time he at odds with fallibility and shifted response to an ultimate instance. On the other hand, it still is a human instance. What we should probably adopt from this example is to adhere with human fallibility, which comes close to accept infallibility to ourselves. If we still want to accord infallibility to a higher instance then arts would be a better option than algorithms derived from a retrospective scientific approach.

#### Performative science examples

*Evelynsöböl (with Lasse Scherfing and Sebastian Fischer, 2003-2004)*

In our own research we developed a content-based image retrieval interface that uses an eye-tracking device. In the beginning of the search, a collection of about 20 images randomly retrieved from the database are shown. The attention paid by a user to each image is measured through the gazing times that the images receive. These are detected with the eye-tracker. The collection of images is progressively replaced. The records of gazing times are used to anticipate the searched-for category. The search progresses by supplying more and more images that come out of the desired category. In developing this interface, we faced the problem of an anatomy contained within the concept. An efficient and perfect adaptation to the most desired category keeps away from any future correction. The remaining category can never be disapproved, but only be confirmed through gazing at the images since no other category is left. Whether or not this is welcomed by the users depends on their attitudes.

In our research, we expected a context-sensitive image search, which would include the adaptation of the categories themselves. However, we soon recognized that it was impossible to include self-modifying features in the algorithms required to formulate new hypotheses. In order to get a rough feeling for the cognitive processes related to the emergence of novelty (i.e., creativity), we started to provoke users of the interface

by only providing categories that were unlikely to be desired. Such a shift in perspective – a kind of perversion of the original idea – has the potential to call attention to the otherwise ongoing *Verdinglichung*. Moreover, this counter-adaptive behaviour may stimulate interesting new ideas. Mixtures of adaptive behaviour that rests upon best evidence derived from the tracking data and irritations through counter-adaptive applications are also possible. How much irritation through random or counter-adaptive processes stimulate new ideas depends on individual conditions. Our studies suggest that the necessarily retrospective characteristics of the algorithms prevent them from self-modification, which would, however, be a necessary condition for creativity.

There is a clear gap – the interface – between process and retrospective methods of sciences and engineering. In other words, information engineering is an operational hermeneutic enterprise, i.e., a mixture of deriving operational directives from past behaviour, and remaining at the same time open for the process. Unfortunately, it seems to be almost impossible to publish such an approach in most of the pertinent IT journals. Absurdly, the peer reviewers ask for evidence for efficacy and efficiency, proving how difficult it is to introduce the performative concept, which, in a sense, is opposed to efficacy and efficiency.

*Al-Arena (with Rüdiger Hinterwälder and Florian Grund, 2004)*

Simulated agents in an environment with food resources can be endowed with different strategies by the visitors of the museum. This is the prototype of a long term project including the public into the research process. Two levels of investigations can be distinguished. The first level is the analysis of the simulation. Which strategies survive? However, in our experience, the result of a artificial life simulation is partially already pre-determined by the programme, thus by the programmer. Inevitably, conscious or not, the programmer's "prejudice" determines the output. Therefore, the second level is perhaps much more

interesting. Which strategies are preferably chosen by the users?

Robert Axelrod performed some years ago an interesting tournament of algorithms [33]. He asked several academics as well as non-academics from different fields to submit an algorithm that plays the famous iterated "prisoner dilemma game" pairwise against all other algorithms. The pay-off in each step of the iterated game depends on the decision of the opponent algorithm. Therefore, an effective anticipation is needed. I refrain from presenting details of this highly interesting game. The crucial point is, that in a first round the Bayes algorithm, which was regarded as highly sophisticated, turned out as a very good strategy, although the winner was the simple tit-for-tat strategy. However, in a second round of the tournament, after the first round was allowed to be analysed and the algorithms to be changed, another Bayes algorithm was submitted that tried to anticipate whether the opponent strategy is a Bayesian one. Such a change of hypotheses is – at least up to now and possible in general – beyond the possibility of algorithmic self-modifications. That the decision making process and adaptive capabilities of human brains obeys a Bayesian inference principle is a category mistake. Bayes' principle is universal in that sense, that with it any decision making process can be approximated and mimicked to a extremely high degree.

Since we assume that the human creativity cannot be algorithmised we want to provide in Al-Arena and subsequent projects user interfaces as simple as possible and at the same time allowing for sufficient complexity to use all the available manpower. The crucial point is, that the model contains that what is to be modelled and does not reduce to the essentials. The existentials are at least tried to be kept alive. There is not an exact recipe to achieve that. In the case of Al-Arena it was very informative to see the users change and adapt their strategies when visiting the installation more than once. We currently work on an online version for the internet. The museum version run on the LAN only using two terminals.

It can be concluded that performative science is close although not identical to art. It is a balancing act between an artwork as the result of research and a traditional scientific publication and communication form. It should be clear, that this approach is definitely not generalizable. It makes more sense to deal with the interface as long as there are the two poles of art and science. This suggests to treat performative science as a new episteme.

Liquid Perception 2D (with Sven Sahle, 2000)

Liquid Perception is a simulation of a neural network that can be excited by an external stimulus taken from the live video of the spectator moving in front of the video projection. The artificial neurons are arranged to a (circular) 300x400 array (or a cube in the 3D-version) and connected to their neighbours. The activity of the neurons is colour-coded whereby the bright areas code for a high activity. In a specific parameter setting which has been chosen to mimic excitability as a result of the "playful" interaction, the network reacts such that if no stimulus evokes the network it will reduce its activity to a small background noise. An external stimulus excites some neurons. The activity of those excited neurons start to spread over the whole network as a result of the neuronal coupling. The activity synchronizes to a coherent dynamical pattern that encodes the perceived stimulus in an abstract representation.

Although Liquid Perception is far from modelling characteristics of a real brain it yielded valuable insight in the functioning of neural networks. In an analogous way like Al-Arena, it was the interaction of the spectators that yielded some exciting insights. Human brains seem to have a tendency to strive for synchronization. Two productions of Philip Glass' and Bob Wilson's "Einstein on Beach" directed by Berthold Schneider in 2001 and 2005, respectively, allowed for valuable observations [34]. The spectators move in front of the excitable neural system and try to synchronize pattern movement, their own movement, and musical rhythm. In this sense, the brain is a

synergistic system that strives for eigen-dynamics according to Hermann Haken's so called "enslaving principle". Please note, we have (potentially) the freedom to choose the "order parameters". How we do this, is subject to a performative approach. The observations during the opera productions count to my most valuable performative scientific experiences. I am well aware, that the success of this "art/science" event was due to a consistent general setting including all other positions from acoustic and visual arts.

Concluding remarks

One of the major ideas of performative science was to search for a method that allows for a corrective or in some cases a normative element within the process of science that usually lead to Verdinglichung. Asking a blind man what he is experiencing, he tells you about an obstacle, possibly a chair, a table, this or that. But he will not talk about the stick he is intimately holding in hand, the medium that helps him construct reality. Only the broken stick will show him a different reality. To break the blind man's stick is a somewhat harsh metaphor for twisting out of Verdinglichung. However, this is what some eminent net artists and new media artists did when they provoked with machines that did the opposite of what was expected. A guiding motif for performative science is to construct tools that contain such "twist-out" elements, which is an ambitious and most likely impossible target. This again shows that art should remain autonomous from science on the whole. Otherwise, we get over and done with the balancing moment between the cultures.

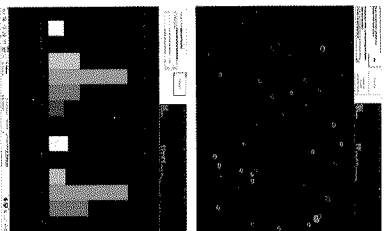
Meanwhile, almost all "big" companies (HP, IBM, MS) work on tools for monitoring and controlling the web with the aid of the whole community (see e.g. [35,36,25]). Grassroots democracy seems to me to become identical with a kind of absolutism. People start to act like there is no reality out there. Artists are essential contributors to the developments, some of them documented in the blogviz thesis, for example [25]. Paul Klee's characterization of art as "making things visible" turns into a farce. Radical constructionism evolved into a radical social design that reduces Being

to its essentials and strips away existentials. I am very sceptical when the internet is so emphatically equalized with democratization.

Barbara Bolt wrote a fascinating book on "Art beyond representation" [37]. It is astonishing that there seems to be the necessity in 2004 to remind us that there is an element of art that cannot be captured on the basis of representations. For me, this insight was the starting point to construct a performative science that accounts for the process. A lot of Bolt's arguments can directly be transferred to performative science. To conclude, Being cannot be reduced to invariant and stationary structures. Traditional scientific methods do not account for contingency. Keeping this in mind, it is well an advantage of science when applied to areas that are want to be kept invariant. However, with respect to society it is highly controversial which parts are want to be kept invariant. In these cases, invariance appears to be very comfortable, no doubt. Perturbations would then probably be stimulative. In my conception, art is a good candidate for the production of perturbations. Performative science in a more constraint way, too. I, therefore, want to strengthen the old Heideggerian idea of one – but an important one – arts mandate: To twist out from Verdinglichung.

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Al-Arena as presented in the ZKM Media Museum in 2005. The user can create a species and evolve it with a survival strategy. The visualisation of the agents has been done rather minimalist. The idea was not so much to focus on an aesthetic visualisation but rather on the concept of a museum as laboratory. The GUI allowed to chose both "internal" statistics of the species and "external" method tries to understand strategical thinking in a performative way.



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