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Article

The Causal-Compositional Concept of Information—Part II: Information through Fairness: How Does the Relationship between Information, Fairness and Language Evolve, Stimulate the Development of (New) Computing Devices and Help to Move towards the Information Society

Gerhard Luhn

Faculty of Computer Science, Technical University of Dresden, Dresden 01062, Germany;
E-Mail: gerhard.luhn@tu-dresden.de; Tel.: +49-351-463-38529; Fax: +49-351-463-38460

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Abstract: We are moving towards the information society, and we need to overcome the discouraging perspective, which is caused by the false belief that our thoughts (and thereby also our acting) *represent* a somehow externally existing world. Indeed, it is already a step forward to proclaim that there exists a somehow common world for all people. But if those internal forms of representation are primarily bound to the subject itself, then, consequently, anybody can argue for his or her view of the world as being the "right" one. Well, what is the exit strategy out of this dilemma? It is *information;* information as understood in its actual and potential dimension, in its identity of structure and meaning. Such an approach requires a deeper elaborated conceptual approach. The goal of this study is to show that such a concept is glued by the strong relationship between seemingly unrelated disciplines: physics, semantics (semiotics/cognition) and computer science, and even poetry. But the terminus of information is nowadays discussed and elaborated in all those disciplines. Hence, there is no shortcut, no way around. The aim of this study is not even to show that those strong relationships exist. We will see within the same horizon that, based on such a concept, new kinds of computing systems are becoming possible. Nowadays energy consumption is becoming a major issue regarding computing systems. We will work towards an approach, which enables new devices consuming a minimum amount of energy and maximizing the performance at the same time. And within the same horizon it becomes possible to release the saved energy towards a new ethical spirit—towards the information society.

Keywords: information; causality; composition; physics; semantics; information society

This paper is dedicated to Wu Kun and the Chinese approach to Information.
Information creates and releases the energy of our mind.

1. Introduction: "Information" Is Based on a Natural Disposition towards New Composition

A major impetus for Robert Mayer when he worked towards a common concept of energy was the study of the color of blood. Working as a medical doctor, he analyzed the blood of sick sailors in the Dutch East Indies. He found that the venous blood looked bright red, almost the same as arterial blood. Mayer knew that the venous blood from people in Germany was much darker. He learned from the chemist Lavoisier that the body's use of food amounted to burning it in a controlled way to supply warmth. The darker venous blood contains the ashes to be delivered to the lungs and expelled as carbon dioxide. Mayer concluded that in Germany it is usually much colder than in the Dutch East Indies: Less burning of food was needed to keep warm in the tropics, hence the less dark blood. Robert Mayer then developed the "food = heat" equation and argued towards a "mechanical equivalent of heat" in the year 1842. Finally, he calculated the equation using results of experiments done earlier in France on the specific heat of gasses. In other words: Very diverse and light-minded appearing relationships composed the soil for the development of a new concept of energy, which is nowadays used in a consistent manner in all kinds of different disciplines, like natural science, medicine, poetry, or engineering design. Energy is not a substance, but a dynamic transformation rule of conservation. Likewise, information is not a substance, but a dynamic transformation rule of structural conservation and growth. And the topic, which is analogous to the "color of the blood" of a new theory of information, is the potentiality (including its non-algorithmicity) of any information. To bring it into an equation:

$$\begin{aligned} \text{Information} &= \text{actuality} + \text{potentiality} \\ &= \text{actual state of a system} + \text{potential next state/including emergent states} \end{aligned}$$

The common thread of this study draws itself around an explanation of the relationship between the actual and the potential dimension of information. Actual information exists of structures, which are well developed and mediated within transformation rules in natural and social systems. A typical characterization of those transformations is the fact that they do consume very little energy and have the function of controlling and stabilizing the overall system. Energy is consumed through the successively executed motor/mechanical functions. Potential information is composed and transformed into actual informational structures in order to create new overall structurization and save energy at the same time. The physical background and necessity of this process has already been outlined in Part I of this study: It is grounded in the dynamic interaction of the second law of thermodynamics and the Pauli Exclusion Principle. There is a natural tendency towards the composition of new structure. A major pillar and building block of modern society consists of computing systems. A new concept of information has to enable new kinds of computing devices, which save within this unique design and conceptualization adequate amounts of energy. This will be achieved by integration the physical dimension of information into computing science. And at the same time, the physical and compositional dimension of information will enable to move towards a new ethical spirit.

We are moving towards a new concept of information—a very similar situation as Robert Mayer and his companions experienced in 1842. For this reason this paper (including Part I) addresses a diversely viewing, but systematic combination of overall converging topics. "Information" is nowadays seen as a technical, social and ethical core concept; but it remains unclear, if it holds the character of a fundamental natural category (like the concept of energy), or if it is restricted to the domain of pure thinking, or if it is primarily bound to computer devices and computing science. Approaches to a concept of information have been made in many such domains. For this reason the concept of information is grounded in natural science (physics), in semantics, and in the fundaments of computing science/informatics. A new concept of information reveals the power, which comes out of a new, natural and elegant relationship between those disciplines, and has—as an empirical proof—to show the potential for new kinds of computing systems. Nowadays the consumption of energy is becoming a major issue of modern computing devices; new paths for new and alternative developments will be shown. The main thesis and outline of this study is to show that we need to move towards a unification of somehow disparately looking subjects like physics, semantics and computing science. Where did this interrelationship start? We have to move far back—back to the roots of human appearance.

Chapter 2 introduces the anthropological roots of language and fairness, leading to the potential dimension of information. In one word, fairness leads to authenticity, which we will lose if we maneuver ourselves into a merely passive and consuming position. The knowledge of the potential dimension of information supports us in overcoming this situation.

Chapter 3 ("The Potential Dimension of Information") focuses on an explanation of the potential/compositional process towards an inverse view on classical semantics. This view supports a characterization of the potentiality of any metaphors and opens the perspective towards a cultural, "informed" and free self. A self is a recursively transforming and reproducing system, and hereby creates a universal unity. This is achieved through the usage of language in order to prepare and mediate further individual and social transformations. Such language also lays the foundation for culturally developed algorithms and computing devices.

Goal of Chapter 4 ("The Actual Dimension of Information") is to emphasize the development, absence and destruction of knowledge. The perspective of a concept of Identity-based Computing is introduced. This gives evidence for the design of computing devices, which may operate with minimum energy consumption and maximized performance. The worldwide CO_2 emission of all computing devices has already passed the CO_2 emission of the worldwide air traffic. The proposed concept of information supports even a way out of a subject-bound representationalism, because this mind-set will be unmasked as the root blocking point for the design of new computing systems.

Finally Chapter 5 introduces the perspective of an actively composed self, which has the inherent capacity for a new ethical spirit. Information science has to develop this path, in order to show that the "information society" is more than a mere metaphor, and to subsequently release the energetic forces which will be set free through a clarified concept of information. Among information scientists and philosophers known to me, only Wu Kun has described in adequate philosophical depth the relation between the reality of our world and the role of an informational ontology in its understanding and the creation of a complex compositional self [1,2]. Finally, the information society may evolve out of the compositional usage of computing and information systems.

2. Anthropological Roots of Language, Fairness and the Potential Dimension of Information

2.1. From Our Moral Stance towards Computing Systems

During the growth of the Great Rift Valley in Africa a couple of pre-human species (variations of *Australopithecus*) were forced to develop an upright position. The savannah was growing, forests were disappearing and our antecedents were forced to develop new sources of nutrition. Some of them were lucky, and they found new sources, which were very rich in terms of protein (eggs, birds, insects, meat). This kind of nutrition caused an unplanned growth of brain substance, as a kind of synergetic side effect. And due to the upright walk, their hands were freed for further usage (development of gestures and signals, production und usage of tools). Our antecedents gathered an enriched overview, over the Savannah, the Great Rift Valley and their own life. They discovered the relation between sexuality and the birth of their children. They discovered the continuity of life and its sudden end. From this point on, they developed spirituality, artwork and kinds of religion ("religion" was an evolving set of rules in order to organize the social cooperation, handed over from generation to generation, and mediated via an emerging language). Language was—during the Age of Enlightenment—understood as personally expressed poetry (greek *poiesis)* and poetry was thought to be older than any form of language [3,4]. Indeed, within language it is possible to perceive, to experience another person. And—through the phonetic feedback system of consciously heard own vocalizations—to experience and to build the own person; the potentiality of being capable to produce infinite thoughts. Language permits the capability to enroll formerly one-dimensional triggers for ultimate activities into a multidimensional network of conditions and experiences, and stimulates the composition of new ideas. The heart of any such composition is new and causal information, which lays the foundation for a new overall arrangement of each person within her/his natural, biological and social environment. Such new compositions are created and indicated because they hold the capability to save or to use more efficiently the embodied energy with regard to potential action—in other words: to act more intelligently. They are created for the same physical reason why snow crystals suddenly appear out of a humid dust. The creation of such snow crystals dissipates energy, which is—if those snow crystals were imagined as thoughts—stored and kept available for further acting. And for this reason *information* creates and releases the energy of our mind.

The Age of Enlightenment gave us the capability and responsibility to act as free persons. On the other hand, we have been confronted with a couple of (narcissistic) offences: (1) Man is not the center of the universe anymore (Galilei, Kepler, Newton); (2) man's antecedents are animals (Darwin); (3) man is controlled by the unconscious (Freud); and nowadays (4) the mind is a computer; (5) the free will is an illusion (neuro-scientific determinism). It seems that such characterizations overdramatize. But the contrary is true: Man is capable to act like—or even worse than—an animal. To be more precise: It would be a shame to compare the behavior of dictators like Hitler, Stalin or Hussein with those of animals. Man may also act like a computer (the reader may take the rules of taylorism in production technology as an example, where compositional inputs are not wanted: People have to execute exactly and nothing else as what is proclaimed in well specified work instructions). And of course, man may also loose and/or negate his creativity and free will. So a real criterion for our intellectual health and robustness is the spread of the contradictions and inconsistencies, which we are

yet capable to manage, and even derive more intellectual stimulus out of it (the German philosopher Hans Blumberg analyzed this "tolerance for ambiguities" [5]). Any such offence stimulates further movement and insights. And one such insight or hypothesis is the newly proposed concept of information: We are in a continuous and ongoing search for the new, the contradiction, the paradoxical, and the ambiguous. Modern computing technology starts to dominate the world, and acts as a metaphor for being human. This perspective brings us into a merely passive, consuming, causally dominated position (the Germans use the terminus "Sachzwang" (inherent necessity, factual/practical constraint) in order to legitimate own actions which are shown (a) against own opinions, but (b) with regard to external constraints; the usage of this terminus increased during modern, deterministic and technically oriented conceptions of the human being [6]). And as a conclusion we will lose authenticity. The counter perspective of an algorithmic, deterministic point of view: A causal computing machine is a non-algorithmic, compositional potentiality towards the new. "Information = actuality + potentiality", as we already mentioned. Computers are good to represent well-specified and actual messages, but they are simply incapable of composing or developing truely new systems, or new structures of knowledge. Computers are made to manage, communicate and algorithmically transform signals (messages). The reader may recall Part I of this study: Postulate 1: Information is—based on the stability and capability of a system—a structure-/form-enriching message. Brought into a semantical context: *Information is an understood message*. Any understanding holds two aspects: Firstly, it relies on the possibility to embed such a message in a logically coherent manner into its own field of knowledge and experience. Secondly, any understood message stimulates a potentiality towards the new. That is, any message (at least, any message of interest) holds a metaphoric character. The entire field of knowledge may change and develop, based on such a message. I will explain the metaphor of the "lifeboat" later, which helped the crew of Apollo 13 to newly rebuild and use the Lunar Module.

We will gain energy out of an understanding of the interrelation between causal and compositional interrelations of information, and we will refer to this interrelation in the remainder of this paper as "causal-compositional". Furthermore, personally initiated activity will help build towards personal identity—in contrast to externally stimulated, reactive behavior. And personal identity delivers authenticity. Authenticity enriches the transparency of own behavior, because the causes of such behavior are given within the person and not within the external world. And in the long run this authenticity will gain confidence and trust.

This scenario gives a foundation for the structure of our moral behavior and for an evolving moral stance. Typically, our moral stance is made of four components: (a) An intuitive feeling for a "good" behavior; (b) our personal persuasions and beliefs; (c) our longing for a fulfilled life; and (d) our concern for an appropriate respect of the other members of the society we are living in [7]. Those components have developed a strong relationship to one another. Our moral stance has an indivisible holistic character, grounded on personal identity and authenticity. We can already foresee a preliminary decision at this point. It seems that our capability for fairness and fair acting was already present in social systems of apes. The Dutch ethologist and primatologist Frans de Waal discovered the social life of apes and especially of South American capuchin monkeys [8]. Those monkeys have already developed a kind of a social memory and they transmit rules for social behavior. A main capability is their awareness of the fact that they all want to be treated with similar, fair respect and

attention within a group. This means that the capability for fairness guarantees and enables an enriched phase space of the whole society. It seems that our impetus for acting fairly is nowadays somehow decreasing (in Germany this is indicated by a so-called fairness barometer [9]), and for this reason we have to investigate this topic. Fairness or fair acting expresses itself primary not by explicit laws, but by the commonly executed spirit of thinking and acting. Fairness is based on personal justice and decency, and fair acting involves the benefits of all (directly or indirectly concerned) partners. This study emphasizes the topic that information—within its actual and potential dimension—is a *prima facie* candidate in order to improve the fairness of acting. And it will be shown that there is a natural force, which supports the growth of structure and, hence, the growth of fairness. This may encourage us to follow the path towards an information society.

The main category of fairness corresponds to our informational postulate of the tendency and force towards an intrinsic growth of structure of and within this universe. In Part I of this study, we saw that already two simple hydrogen atoms may create eight stable base states, if they compose together a hydrogen molecule. Those states are energetically of higher stability (in comparison to the states of separate atoms). And if the surrounding temperature increases, even more possible states are potentialized. This holds also true for compositions of different kinds of atoms—the precursors of a kind of "fairness" in the existence of molecules as such (example: water, H_2O). That is, such a "cooperation of atoms" acts as an enabler of similar cooperations within chemical, biological or social systems. The main postulate of this study is that the underlying physical principles (the Second Law of Thermodynamics and the Pauli Exclusion Principle) give the foundation for any kind of cooperation. And the category of fairness is the social interpretation of an intrinsic movement towards a maximization of possible or potentialized system states through the ontological category of a physically grounded, causal composition. The reader might note that this process also provides the foundation to our thinking: Maximizing possible system states through compositions of new overall structures at energetically lower levels.

But there is another distinction to be made at this point. Ethology and sociobiology cannot explain the systematic gap between our interests and our moral values and judgments. We might disapprove of our laziness or be very upset because of our envy towards others. But we will not change our behavior with regard to this gap between interests and moral values, at least not immediately. The conclusion with regard to this study is another one. We might be able to articulate our laziness, but this is not done with a causal "power of assertion" (see Part I of this study, pp. 170f). Why? Because some important categories which build our view of the world are not integrated in a dynamic and adapting manner. The understanding of this causally decoupled, although semantic, gap is our entry point into this topic. This is linked to the problem of overcoming externally given, inherent necessities ("Sachzwang") and—as a conclusion—building our own authenticity. The story of mankind began when our antecedents took the upright position, gathered an overview, and forced their own development towards an inherent openness and sincerity. In other words: Our antecedents started to add a consciously experienceable compositional element to our thinking: actively conducted fairness. The aim of this study is to encourage us and to stimulate us to act towards our own authenticity. And this authenticity is—or should be—developed and built with regards to a maximization of overall structural growth; including of course the mid- and long-term perspective. And this is naturally supported by the impetus of fairness and fair acting.

Modern computers are built in structures similar to our social environment (data highways, functional units, fields to recreate, to store new messages and to establish new relationships). Computers may support worldwide and free communication, and may execute automatable functions. Based on such a design, computers may facilitate our path towards an information society.

2.2. Information = Actuality + Potentiality

The easiest way to tackle the dimension of potentiality of information comes from an analysis of our language-based thinking and acting (semantics). This study is based on a new concept of semantics and other complex biological and cognitive processes, which complement classical concepts from within a causal compositional perspective. Joseph Brenner already analyzes the problems of the classical approach in semiotics from a new logical perspective [10]. Brenner concludes that the classical categories of semiotics (representation, sign) are restricted to static and largely abstract information spaces, incapable of dynamic interaction and further development of intrinsically new structures. The usability of such kinds of symbols is not denied, but the goal of this study is to highlight the dynamics and the development character of the informational process. It is based on Brenner's new extension of logic to real systems, based in turn on the seminal work of Stéphane Lupasco [11].

What kinds of categories are candidates, which weaken the relationship between our interests and our moral values? It seems that the prototypes for such candidates are non-subjective, abstract entities which are characterized by a low connectivity with regard to the causal structurization of our knowledge. And a major category of such a kind is called "money". It is not the aim of this study to dismiss the value of this category. But the aim is to provide an informational, causal-compositional characterization of such categories and to propose adequate solutions for the information society. Market mechanisms are important and will not be denied. However, they have to be part of a philosophy of acting, which increases the structurization of this world. As a consequence, subjectivity and the activation of subjective potentials have to be put into the foreground. And one simple concept, which of course follows the "power of assertion", is called fairness (the reader might anticipate John Rawls' Theory of Justice [12]; this study gives further reason to Rawl's approach of fairness as a base category to organize our life and society). "Fairness" is better than "money" or "militarily control", in terms of a semantic and causal concept in order to minimize the gap between our interests and our moral values. And the concept of fairness follows the postulate of an overall enrichment of structure within this world, which holds the state of a natural law. That is, fair behavior will survive and develop by natural evidence. However, such behavior will not emerge for free. It is the task of our conscious experience and our conscious capabilities to create and compose new possibilities, new solutions and new cooperations. And the base concept, which enforces us towards this direction, is the knowledge that fair behavior is favored by natural evidence and feeds any species with energy within a long-term perspective.

All human beings are interested in the new, in pros and contras, in incoherent meanings, in paradoxes, or in art and its irreducible characteristics. Being somewhat aware of this, those configurations enable us to establish our own activity and to enrich our experiences and actions towards new compositions. Part I of this study developed a causal compositional concept of

information. A typical definition of information (information is the reduction of uncertainty) needs to be fundamentally inverted: Information is a compositional activity, including the inconsistent, the paradoxical, the contradictory and the incoherent. However, it is not an unguided process, because it is based on a natural process towards an overall enrichment of structure. The unity of any such structure is defined by one or more physical laws or rules (as a simple example, the law which describes the structure of snowflakes). While the appearance of new kinds of laws took quite long periods during the development of the universe, the cycle times of those periods decreased tremendously through the appearance of living species. In Part I of this study, it was already shown that any thought instantiates such a causally active and newly composed structure. The process of composing such new structures within our mind is based on non-algorithmic superpositions of interacting layers of experience, and the task of our conscious experience is to mediate this process within a language-oriented framework. Algorithmic structurizations of problem solutions have been developed by human beings for some twenty or forty thousand years. In the beginning, such algorithms were invented to organize the exchange of foods between humans. Those capabilities were developed together with the invention of numerical numbers. It is the relatively high level of abstraction, which may decouple algorithmic-like organizations of actions from their causal basis (which may or may not hold the required power of assertion).

Such a study requires the construction and reconstruction of a multi-dimensional configurational space, as well as a computational space, and the introduction of the perspective for new kinds of computing devices, among other things. The creation and consumption of data, which is stored and processed in computing systems, will continue to grow. However, we have to move away from a role as passive data consumers towards beings who are actively composing the infosphere. By doing so, we are opening the perspective for a compositional self and the information society.

I am emphasizing this approach because it seems the only way to give a foundation to the causal and mental energy, which can be derived from the knowledge of this new kind of semantics. We need to inverse our typical, object-centered view and open it to the subjective dimension of structural development. The cohabitation of the second law of Thermodynamics and Pauli's Exclusion Principle enables and forces the development of structure within this world. The knowledge about the physical forces, which are bound to this completion process, will help us enter into a non-normative ethical spirit. We will replace passive notions such as "you should not …" by simple statements, which encourage us towards the development and creation of structure (and which are based on fairness towards others and also towards ourselves). We have already highlighted such a concept, which will increase the structure of this world, and which is semantically bound to the critical term of "fairness".

3. The Potential Dimension of Information: Language, Ideas and the Quest for Freedom

The compositional process will be developed from within a psychological, phenomenal approach, which stimulates a new view on semantics (inverse semantics). This view will be challenged by opening the perspective towards metaphors, the cultural Self and our quest for freedom. But freedom always risks loss and destruction of information. It has to be amplified so that destruction happens from within a restricted local perspective. It happens also on a daily basis (forgetting things) and the cultural mitigation against this is the invention of external, long-term memory (permanently written symbols). All these improvements and the overall progress have been enabled an increasing amount of

fairness within societies. While—coming from the apes' social systems—kinds of centralized control systems played a major role in the beginning, later collaborative and more flexible and adaptable action schemes evolved. Finally the democratic system was developed in ancient Greece. But as of today, mankind still is capable of installing and executing centralized, non-democratic and even terroristic control systems. However, a couple of societies developed an optimized exchange of information. Those systems will tend towards natural evidence and democratic-like structures. Finally it will be shown that the foundations for modern computing technology were invented from within this background.

3.1. Ideas and the Composition of New Inventions: Towards Inverse Semantics and Cultural Fairness

How does one have a good idea or initiate a new design? In language, we find that the words technology (Greek *techne*) and art (Greek *poiesis*) have the same origin. It is a moment of seeing—an insight into—an "abstraction by varying concomitants", which drives and controls such a successful mental process [13]. A commonly cited example of this type of event is the discovery of the benzene structure by the chemist Friedrich Kekulé von Stradonitz. In the year 1865, while a tired Friedrich sat in a horse-drawn tram, he began to daydream of a chain of atoms. At this time only simple, linear molecules had been discovered. The tram was not very comfortable and he had a very wobbly ride. This wobble caused the chain of organized atoms within Friedrich's daydream to dance a very unusual dance, disregarding classical dance contexts. And so it suddenly occurred to him that one end of the chain had grabbed the other end. This was Friedrich's moment of insight. The benzene ring had been discovered. A label for such a creative insight or mental process is "abstraction". The process of abstraction assists in a compositional restructuring of a mental problem field and thereby identifying a new mathematical model.

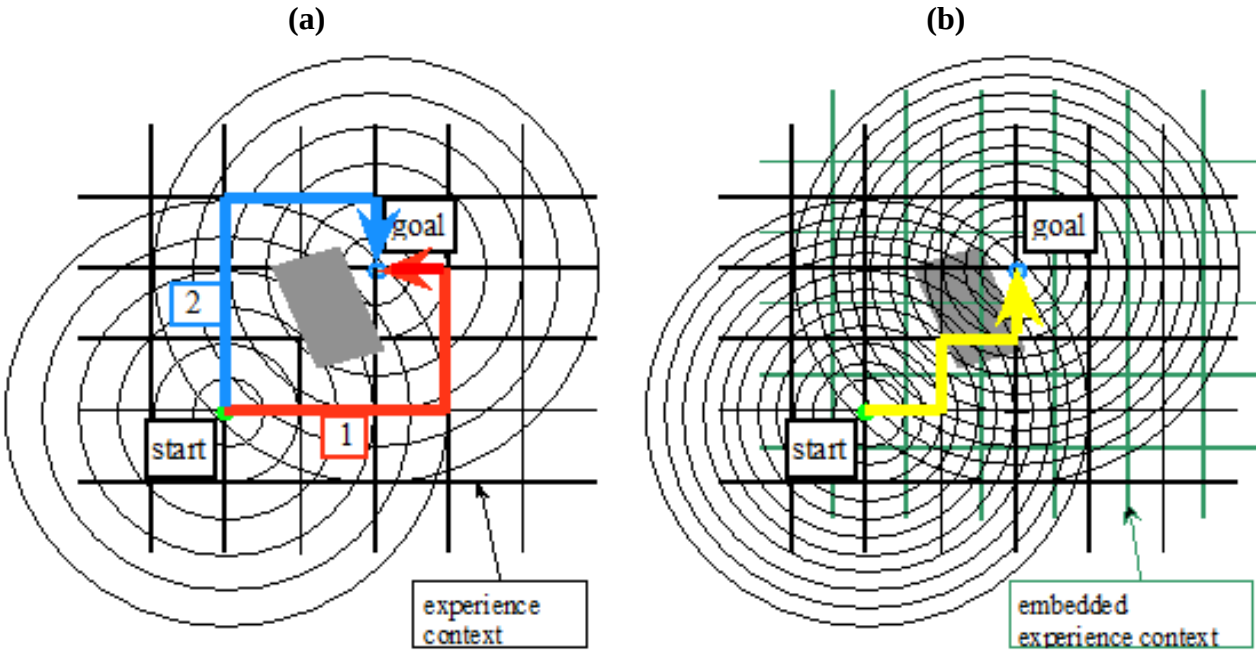
Our classical cognitive concepts of "subject/subjectivity" and "object/objectivity" are an essential part or even a definition of this process of restructuring, as Noam Chomsky showed within language [14]. This very basic structure (verb/subjectivity and noun/objectivity) holds the concept for such restructuring. The rise of any subjectivity and objectivity starts with kinds of activities (*i.e.*, "verbs") of a certain system, which is embedded in the context of certain objects (*i.e.*, "nouns"). Language is a form rather than a substance. Language acts as a *form-giving structure* within this scenario, which leads to a sharpening of our thinking skills that makes them capable of such refinements.

What made Archimedes jump out of the bathtub crying "Eureka"? Emotions are not only side effects of thinking, but they are necessary conditions and mechanisms of ongoing and continuous thought control. Emotions are indicators (signals), which help to identify new, further-reaching connections and possible solutions. That is, emotions are signals to support/enable reasonable acting: Such feelings are identical to the physical fact that those corresponding informational structures are getting ready to be stored within the brain. For this reason, emotions are activities, which happen on a high energetic level, and deliver the so-called "*Gestaltschluss*". This is the psychological counterpart of the included middle. The concept of the included middle was proposed by Lupasco and Brenner [10,11] and was introduced in Part I of this study. If we apply the concept of the included middle to Gottlob Frege's theory of identity of thoughts (as done in Part I, pp. 169f), then it has to be concluded that the emergent state (the included middle) is identical to the concept of *Gestaltschluss* in

psychology. Hence the sudden idea is not to be explained with the concepts of rule-based information processing and semantic networks. Revisiting older theories and results of the psychology of thinking (*i.e.*, Duncker [13]) one can find more promising explanations of the phenomenon. According to these theorists the sudden insight is caused by a "*Gestaltschluss*", the completion of a well-organized figure of thinking. This *Gestaltschluss* can be perceived by the thinking individual and in this way trigger a feeling of evidence. It is the privileged access to compose and identify new causal information.

Let us now map our concept of information to a model of human information processing. Cognitive science typically relies on the concept of a linear vector space in order to conceptualize any cognitive behavior [15,16]. Such linear vector spaces have been implemented within connectionist systems [15]. Within such a connectionist system, activations may be conducted in a bidirectional sense (*i.e.*, from start to goal, see Figure 1). Start and goal are network nodes in our model and a source of network activation. According to classical theories about knowledge representation a certain production rule selectively activates certain knowledge in the semantic network. Contrarily to this, in a connectionist network the experience of an acting system is represented in a distributed way. By integrating a formerly unconnected experience context in the problem solving process (*i.e.*, finding and using a tool) the actual field of experience may be restructured: An abstraction process takes place and a solution will be generated, which is optimized by the experience of the system (the *Gestaltschluss*).

Figure 1. Activation paths in connectionist systems; the green grid (**b**) indicates the appearance of a new model; William Calvin discovered the recursive structure of this process from a language theoretical perspective [17].



A feeling of evidence will be generated in a causal sense, because by finding a optimized stable mental structure the activation level in the neural network drops in a significant manner: The now generated solution is compliant "to our experience and can be executed for example of our motor and sensor subsystems". Activation energy is conducted to other mental subsystems and it is this energetical drop down, which the self perceives as a mental signal. This mental signal has a value for

the system itself: We perceive this "Gestaltschluss" as a "good feeling" or "eureka" as a conscious evaluation of the generated solution. And in this sense such inner signals control our behavior. Please note that this creative abstraction process is primarily action-oriented, nonverbal. In contrary: Also the verbal articulations in language systems are controlled by the system itself in the same manner. There is a growing amount of literature in this area, but I want to point out a recent article by Claude Touzet [18]. He describes a model and possible implementation of the described scenario.

Figure 1a shows the initial activation process and two generated solutions. We assume in this simple example that the two generated solutions have not yet reached a causal state: Nothing happens. Then the system additionally activates another experience context and integrates the usage of a certain tool in order to overcome the problem. By using this tool the actual problem solving context is restructured (an abstraction process takes place): The system can now generate a much more precise solution (a new idea is born). If the activation level now arrives at a causal status (the system perceives this inner signal directly as a "good feeling"), the action will take place. We assume a basic feedback mechanism in the cognitive system, which generates the meaning and content of our thoughts. The self perceived voice might be the predictor of our first thoughts. This process itself activates more distributed experience contexts and so forth. In this way the process of speaking (or thinking as an "inner language") continuously reorganizes the activation of experience in the network. New solutions or "Gestaltschlüsse" are generated.

It is exactly in this sense, that the phonetic representation of speech gets its unique and characteristic meaning. In the beginning, thinking is not an isolated, metaphysical symbol, but a simple, recursive activity, which spins connections between different contexts of experience. This activity comes out of an informational feedback mechanism: The self-perceived voice activates other experience contexts in a causal sense. So continuous speaking does recombine the field of experience, which reflects on continuous ongoing motor and sensor activity. It can be shown that the evolution of technology over millions of years reflects on this competence to build up the ability for continuous acting on very different abstraction levels. But language is only the container and does not itself add any causal meaning to thoughts. On the contrary: If we skip "unimportant" details during an abstraction process, we may risk dismissing the essentials of the task (the goal should be to restructure the task by "Gestaltschluss"). By taking all details into account, the network of experience will be restructured in a way to find possible solutions. A couple of other distributed experience contexts may be activated (*i.e.*, in a statistical, random sense) and embedded in the actual thinking process. It is in this sense that information is added during the abstraction process and also new structural information will be discovered (the "Gestaltschluss"). An atomic symbol does not generate "meaning", but an inverse concept, which embeds mental activities in contexts of experience, which enable further growth of compositional, possible states.

Those assumptions fit the actual results of design research about the use of design tools while searching for new solutions in the design process [19]. In a questionnaire study, experienced designers were asked which kind of tools they used in the different parts of the design process. Especially in the early phases (clarification of the goals, search for solutions) traditional forms of design support (e.g., sketches, plasticine models) were favored in comparison to "high tech tools" like CAD or rapid prototyping. According to our model one can assume that these new forms of design support are not so useful for the search of solutions because the operation of these tools does not allow as much different

personal acting as for example hand sketching. Moreover, sketching takes place not only in the professional context of a designer, but also in many other situations in everyday life. This allows the activation of more contextual information than working with a CAD-system. Abstraction and finding solutions are inseparably connected with each other. It may take a long and difficult process to generate really new solutions, if the problem context does not represent an area of *a priori* insight. Another example is the usage and even the stimulation of the usage of everyday knowledge within the labor process. A methodology was even developed to support the activation and integration of contextual information into the actual problem-solving process [20]. Therefore, we argue for a continuous need of abstraction through the whole process of product development and usage. In order to optimize our thinking process there is a need for all abstraction levels. The consequence of these deliberations should be to conserve young designers' ability of sketching and drawing with their own hands. (Albert Einstein: "My pencil knows more than me.")

What can be done to support the "Gestaltschluss", to support the creation of new insights and thereby act reasonably (any reasonable acting has been identified as an acting, which overcomes existing structures and problems through the creation of new insights/new models of action)? Following the argumentation above, the activation of different possible knowledge contexts should be supported. Those distributed experience contexts—as needed for the activation of good ideas—are very different from individual to individual. Supporting the need for developing individual design styles for tool manufacturing, the influence of language must also be taken into account. A deep, language-driven clarification of the problem of what needs to be solved has a large heuristic value within the abstraction process.

We argue for a continuous need of "re-finding" abstract concepts, of continuous restructuring of the field of experience in order to generate optimized solutions. Psychological research has already shown that ongoing reflection and self-speech has a high problem-solving value (the psychologist Vygotsky argues that speech "converges" through the development of practical and technical abilities and that this convergence is the most significant moment in the course of intellectual development; details in [21]). The utilization of speech itself—even within totally other experience contexts—supports this approach, because language offers a much more flexible scheme for creating new models.

However, we have to remark that those tendencies of semantic convergence primarily appear in regard to developments within the subjective sphere. Objectifications like tools play a secondary, but nevertheless important role. How are our moral intuitions grounded within this scenario? Intuitions like "don't kill other people" or "don't practice incest" are a product of evolutionary pressures in order to shape and develop the organization of social life. Based on the success of such intuitions, Herbert Spencer explored the so-called "social Darwinism". And still nowadays, a movement towards "naturalized ethics" can be noticed (Mark Hauser argues that human beings have an innate moral sense [22]). The position of this study is that—of course—there is a certain and maybe fundamental value to concepts like "fairness". However, there is no reason to only rely on moral intuitions as a source of our judgment. For example, religious fundamentalism and violence can in the long run not be eliminated via violence. Or, the growing gap between the poor and the rich cannot be reduced if the causal reasons for this growth are not addressed. That is, we have to develop a healthy distrust of moral common sense. Our social instincts were not developed for the modern world. For example, we

have to continue to enforce personal trust and responsibility within a communicating world. And a main category to support this goal is indeed fairness.

3.2. From Metaphors towards Language, the Cultural Self and the Quest for Freedom

> "For the final truth about snowflakes is that they become more individual as they fall—that, buffeted by wind and time, they are translated, as if by magic, into ever more strange and complex patterns, until, at last, like us, they touch earth. Then, like us, they melt." (Gopnik, Adam: "All Alike." Comment in the New Yorker [23].)

A metaphor transfers an innovative informational content from an initial description of a certain scenario to a metaphoric, but innovative target description of the scenario. As Gerhard Kurz states, any relevant metaphor is a living, innovative metaphor [24]. While the term metaphor comes from Greek metaphorá (meta = over; phérein = to carry) the point is not just to carry something from one place to another place. The point is that this movement has to be innovative in terms of enriching the current system structure in order to trespass certain system boundaries and limits. And that is—in the end—creating a new kind of identity, governed by a new or enriched set of rules.

The reader may recall the disaster of the Apollo 13 mission. While the mission was on its way to the moon, a fault in the electrical system of one of the oxygen tanks produced an explosion that caused both oxygen tanks to fail and also led to a loss of electrical power. The crew had to leave the Command Module and used the Lunar Module as a "lifeboat" during the return trip to Earth. The consumables in the Lunar Module were intended only to sustain two people for two days, not three people for four days. A very serious problem was the required removal of carbon dioxide. Ground control developed a new way of recharging the "lifeboat" by using the consumables, which had originally been placed in the Command Module. The cube-shaped Command Module canisters had been connected to the Lunar Module by drawing air through them with a suit return hose (see Wikipedia for more details). The aim of this example is to show parts of the deep structure of the information on "what is the Lunar Module". It was never designed in technical detail to act as a lifeboat. However, it became possible by newly connecting available information regarding all parts of the system and putting this information into a new relationship. The "lifeboat" metaphor acted as a new and stimulating idea in order to create a new kind of system, which was called "lifeboat". This metaphor has given a new identity to the Lunar Module. While the usual understanding was that of a "landing vehicle" in order to approach the surface of the moon, this system (with some adaptations) has now become a "lifeboat". This new ontology teaches us that identity is developed towards new identities (which formerly were non-identities). Paradoxical statements become metaphors.

In this respect, the concept of "truth" does not refer to features of atomic statements, but to the validation of the restructuring process of complex systems of knowledge. When the content of a system of knowledge has to be put into a higher category, the statement serving as a cause (*i.e.*, initial problem-solving structure)—if validated—can be called "true". For that, an explication of the "content of knowledge systems" relates to the measurable information content of *Gestalt* (shape), which manifests itself in structure (number of possible system states) and process (possible dynamic structure transformations). From the anthropological-historical perspective, such knowledge structures refer first to the spatial-static and then (especially since the invention of agriculture and complex social systems)

increasingly to the dynamic-process-like shapes. In this respect, the mental modeling of processes happens on more abstract levels than the modeling of static objects. Furthermore, from the perspective of an overall identity, they are considerably more demanding and richer in content with regard to system theory. The content of such structures corresponds to the durability of our knowledge.

Our "feeling for something" results from a constant integration of at first undetermined cognitive system conditions. The crucial processes of anthropogenesis are marked by the integration of so-far unconnected processes of problem solution to what we finally call "thinking". Reflected on the evolution of the brain, the key element has to be seen in the common use of newly emerged brain areas by so-far unlinked problem solution processes. Thus, the processes of problem solution, which result from the emerging reciprocal altruism, and the concentrated tool use (purposeful stone dressing, purposeful throwing) prepare the cognitive ground for multiple, intricate and recursive behavior structures. These structures of overall identity—supported by memory-active functions—are the mental equivalents to "test behaviour in the sphere of the imagination" [25]. In this phase, for the first time, the cognitive system generates structures of problem solutions, which show definite potential for variation. For the first time it is possible to represent a number of different problem solutions to the cognitive system for disposal, which are beyond the innate mechanisms. In the neuronal substratum—theorized for example as a connectionist system—the "quality" of the respective problem solution is signalized causally to the cognitive system using the respective integral activation potential. This activation potential retrospectively signalized to the cognitive system (in the innate behavior, this still leads to compulsive actions) is the anthropological origin of our concept of truth. This "feeling for the matter"—further developed into verbal statement systems—leads to what is attributed as "true" or "false" in binary logic. Here I find it important to emphasize the context relatedness of this inner signal of truth. For the cognitive system produces problem-solutions (in the synthetic case) by putting previously unconnected, distributed contexts of knowledge into new structures and relations.

From the perspective of an anthropological reconstruction of these crucial phases, the following can be argued. Several considerable, rapid increases of brain volume are detectable. These new volumes themselves lead to an indetermination of the cognitive system. This means that the activations, which so far have been transformed into actions, can no longer relax, *i.e.*, they remain "unfinished". Determination is achieved again when the activation-energy is able to relax by means of the hitherto stored informational structures. For this, previously unlinked contexts of knowledge in the cognitive system are "tested". (Bickerton calls this "offline-thinking" [26]). In the beginning the sound accompanies the action only "accidentally". This sound simply results from an unintentional, marginal activation of new brain areas, which will later form language centers. The growth of the neo-cortex of the brain was stimulated by a change in nutrition towards enriched and protein-based sources. The structure of the face was enriched, and this process laid the foundation for the development of unintentional, non-syntactical vocalizations, which accompanied the activity of the body. At first, these additional activations cannot be relaxed, and then, in turn, they spontaneously activate (in a compositional/statistic sense) further contexts of knowledge, which are not yet in any causal relation to the present activation schemata. This happened through the capability of *hearing* those vocalizations, identifying them as *self-spoken*, and putting such "unintended" vocalization into a context of acting, where such kinds of vocals may have been pronounced earlier, maybe in similar or in other situations of acting. This lead to what can be called a further "dynamization of boundary conditions". From this

point on, the concept of abstraction was developed, and symbols in acting became available. A stone could be used as a "discus" to throw or as a "knife in order to butcher meat".

Those new relationships are enrolled and "tested" from within a pragmatic perspective. Therefore, a symbolically orientated sound language emerges as a means and medium for reorganizing the experience. The communication aspect of language does not primarily promote the creative generating of new thought structures, with new shapes; what seems to be more important is the role of language as a means of the mental (also technical) organization of thinking and acting, against the background of a growing number of cognitively undetermined system conditions. In this sense, man has to be conceptualized as an "open system" [27]. Activations, which go into new areas of the brain and first of all lead to "pending", may be contradictorial reflections;

(a) They are marked firstly by their direct reference to behavior (*i.e.*, as a "side effect" of motoric and perceptual activations), *i.e.*, they are in a certain isomorphic relation to them;
(b) Secondly, they generate their symbolic content by activating other, distributed contexts of knowledge in turn, which they put into an overall structure of identity. That way they produce newly shaped information.

This can be reconstructed in the anthropological record, and consequently, the history of technical behavior can be developed in the context of cognitive evolution. The evolution of language and technical behavior is, therefore, closely linked—the significance of this link with regard to the theory of realization being the subject of an Inverse Semantics as outlined here: Distributed non-verbal contexts of knowledge are the mental prerequisite for the spontaneous generation of new problem solutions. Though the preconditions have been laid down in order to first create fully automated systems (automatos, *greek* "self moving").

We now come to the following conclusion: "Truth" is continually generated anew in the cognitive system by putting new contexts of knowledge into relation, and by creating paradox, incoherent, contradictorily, non-included relations. The level of truth of a thought is signaled to the cognitive system by means of the activation potential of the respective problem-solving overall structure, which indicates the increase of possible states with regard to the overall scene.

> In short: Information indicates the new state of a system, which has been actualized and composed due to the reception of an event ("message", "signal"). This new state relies on the actual structure of the system, but may include potentially new, emergent structures as well. Information. That is, information is an understood message.

The content of information is given by the (newly) accessible, potentialized system states, based on an actual activation status of the system. This activation status depends on internal and external events of activation. Typically, such an event ("message", "signal") is given by the amount of energy/mass and its structure, which is transported during this event. After having received (or emitted) such an event, the system state changes to one of the potential possible states. This transformation process does not only act like a selective sieve, but includes—prior to any selection—the possible entry into a new physical phase space (a new system composition) and thereby the appearance of an enriched world model, which describes the possible new states of such a system.

We assign a certain spontaneity to mental processes. Such spontaneity is based on the capability of systems to develop towards more complex structures, if certain boundary conditions have been dynamized. However, such an appearance of new structures is also given in physics. The very first appearance of a snowflake is an example. In the end, we assign the terminus "Information" to two kinds of events:

(a) A system gets transformed, but the system structure does not change;
(b) A system gets transformed and its structure does change (instantiation of a new phase space).

Case (a) indicates no new information (but indicates the availability of all information about the system itself); case (b) indicates the development of new information. Now, the concept of spontaneity has to be conceptualized from within two perspectives: First, from an overall perspective, including the full information about the physical scenario. An example is the well-studied process of assembly (or composition) of snow crystals. Second, the concept of spontaneity can be understood from within a local, system-internal perspective. This is typically the perspective of us as actors within this world. However, from within a system-internal perspective, the appearance of new overall rules (the appearance of new ideas) holds a non-deterministic, spontaneous character. This spontaneous character is a consequence of further dynamization of boundary conditions. And as this process holds an individual's perspective, both items (individuality and non-algorithmicity) underpin our experience of spontaneity. Immanuel Kant mentioned that humans are capable of creating and initiating new causally active chains of events [28]. The proposed concept of information helps us to understand that if we are doing so, and if we enrich nature at the same time with regard to an increasing number of system states, then nature will even feed us with energy and will support us in the further development of our ideas.

The proposed language-based instantiation of meaning can be explicated as a non-public, personal theory formation which can be mediatized only by a further link to a culturally standardized language sign system. Only this verbal representation creates the prerequisites for interpersonally reconstructible statements, which can be "unwrapped" from the verbal sound. By means of the syntactic encoding machine, the reconstruction process then relates again from the heard sound and a "wrapping and unwrapping" of the communicated thought to those contexts of knowledge, which have been activated by the speaker for producing the problem-solving structure. Language as such (as an assembly of words) is without meaning; what creates meaning is the overall identity of interrelated activities in terms of an overall system of causation.

The quest for information can now newly be answered. Information is primary given through the transformation rules and scenarios of a receiving system. The portion of energy/matter, which causes such a transformation (and what we call a "signal"), does not "contain" information. The informational content is (primarily) given by the transformation of the receiver; but it is also related to the sender. For living systems for example an incoming signal may trigger a certain activity. This activity is activated by consuming only a very small amount of energy. Further motor steps consume a higher amount of energy (which are caused, for example, by friction). From within this background an overall, dynamical network of causation is instantiated. From a pragmatic perspective, an activity is called "true", if it reaches its goals. A statement is true, if it is done with what Gottlob Frege calls the "power of assertion". This points to a new understanding of semantics. Any true statement is

embedded into an overall physical (and semantic) field of causation. Because any statement refers to kinds of activities within this world, and any kind of activity has to be characterized from within a physical perspective. Such "power" indicates an isomorphic relationship between the statement and the physically described causal embedment of such a statement (a "thought"). Those transformations of systems are based on laws ("thoughts") and delivered as an output of the actualized system state. This state plays a part in all possible, potentialized system states, including newly composed states, due to a change in the system structure and system law.

If new information appears on an individual level, systems become capable of instantiating intrinsic (phenomenal) states and will expand structured fields of individual, common transformations. Due to lawful, overall laws/rules (information) a physical common and interrelated field of relationships is created. Such a structured causal field is the reason that similar paths of activity arise, the very precondition of what we call *experience*. Such experience is the culmination point of a process, which "optimizes" the sensory and motor equipment of systems. Please note that the content of this intrinsic state is a logically spelled out substructure of the overall set of physical laws. Those are the two sides of information, physical and phenomenal (semantic).

We can now explain the concept of a "self". A "self" is a recursively transforming system; it is a self-system enabled through the concept of identity and reproduction. Noam Chomsky examined within language a very basic structure (verb/subjectivity and noun/objectivity). This already includes the scenario of identity and non-identity (composition of new identity). Because any verb can be composed to any noun, within endless chains and endless hierarchies. The rise of any subjectivity and objectivity starts with kinds of activities (*i.e.*, "verbs") of a certain system, which are embedded in the context of certain objects (*i.e.*, "nouns"). The nouns reflect the environment of the system, and the verbs reflect the kinds of activities of the system. Language is a compositional form (we would say: *a process*) rather than a substance, as Saussure pointed out. Such a form is given by the specific phase space, which is set up by language. It is the medium of freedom, of personal identity and authenticity.

This freedom demands and postulates personal activity, which may in the end support and enable our longing for a fulfilled life. But once again, there is no external, "objective" truth or objective target structure given in order to anticipate such a fulfilled life. The sky is explicitly given to us, but not the objective appearance of a good or fulfilled life. We can now argue for a new point in this debate. We have already shown that we may reach the conditions of a good life, if we enrich the worlds and our own possible states. And if we do so, we will include the possibilities of our children's life and of any future life into our perspective. That is, we will also tackle the question about the universal conditions for creation and continuation of life. This question is given to us by nature as a task.

4. The Actual Dimension of Information: From the Destruction/Absence of Information towards Culturally Developed Computing Systems, and out of a Discouraging Representationalism

4.1. Consciousness and the Argument of Destroyed Information

Any hunter who holds the information about the behavior of an animal may successfully catch and kill such an animal. So it seems that "information" has destroyed structure (or other information). However, this is only true from within a local perspective. We have to look at the overall, global

scenario. The "information" (as kind of knowledge) of the hunter is required to extend the life of the hunter, who will by himself create new structure. He may be the father of children; he may also become a farmer, *etc*. That is, within our universe, information is increasing. We know by experience that a fire burst may destroy plants, but may also cause the sudden creation of minerals, which are required for further growth of other plants. Even within the biological sphere, it is well-known that on the one hand species are dying, but on the other hand more complex species are appearing on the scene.

Two more examples were given by a reviewer. "A professional murderer can remove all the traces of his or her crime. With the fire in the library of Alexandria a lot of information was lost forever. Some was saved by Arab scientists who made copies—but far from all." Those examples deal with the semantic dimension of information. It is correct that the singular semantic information of all the lost books of the library of Alexandria are not reconstructable anymore with regard to their given singularity. But our historical sciences are trying to reconstruct such kinds of information. The experimental anthropologist gives another example. But why could we be optimistic that such a reconstruction could succeed somehow? The answer is based on the fact that we are interested in the completion of our historical records. The other pillar of the answer is given by the structure of the conscious process. Both pillars serve to better "understand" our own state and corresponding phases of development. And—based on such newly discovered insights—we can expand this knowledge towards new structures and possibilities. We are constantly in search to understand where we are coming from and where we should go. For this reason, we are enabled to start a certain reconstruction of the library of Alexandria on a preceding level (collecting information about the books from within other contexts; even the collection about known gaps and known losses is helpful). On a first glance it seems that information is lost. But this is only true for a local semantic perspective, given within an unnamed cultural background. We know already today much more about the library of Alexandria. I am pretty sure that we will discover much more details in the same manner, as we have discovered the development of human beings at all. What about a professional murderer or criminal syndicates like the Mafia? In short words, such persons or groups act on a restricted local perspective. But murderers do not represent the majority of people. That is, also a murderer has a certain access to the information that he is acting unnaturally from within a fundamental perspective. He does not follow the target to increase the available amount and potentiality of activities from within a global perspective. He knows that he is very restricted with regard to his social activities. He acts within a closed sub-society, and there seems to be not much room for personal development.

The anthropologist Terrence W. Deacon argues for a concept of absence as a fundamental basis of any information. Deacon sees clearly the need for a unified theory of information. Without going into details, it can be argued that his concept of absence (or incompleteness) holds close relationships to the potential dimension of information and its capability to develop towards new structures. He gives the following interesting example:

> "Consider the concept of 'patriotism'. Despite the fact that there is no specific physical object or process that constitutes the content of this word, and nothing intrinsic to the sound of the word or its production by a brain that involves more than a tiny amount of energy, its use can contribute to the release of vast amounts of energy unleashed to destroy life and demolish

> buildings (as in warfare). This is evidence that we are both woefully ignorant of a fundamental causal principle in the universe and in desperate need of such a theory." [29]

This example points out a crucial topic. The reader may think about the so-called sleeper terrorists. Such sleepers are not currently active and simulate something like a "normal life". That is, sleepers hide their personnel authenticity in their words and actions. In other words, there are tendencies towards a growing gap between the content of speeches, talks, *etc*. and real intentions in acting. On the other side, engineers in industry usually try to act according to their words ("he is well known because he does what he is saying"). Of course there are many exceptions, but it seems that an overall and somehow accepted system of values may exist and influence the spirit of acting. We have already mentioned the behavior of certain bankers as counter example. In fact, it seems that a growing gap between the objects of acting to what we call reality simplifies or supports a path to local optimizations like egoism and distrust.

Let us put those examples and arguments into the horizon of the included middle: Due to our ever changing natural and social environment, semantically codified information gets lost, is outdated, or changes its own content towards unknown inconsistencies. This is the normal case, not an exception. On the other hand, the invention of language and of permanent written symbols may help us to mitigate this problem. And the history of human beings has shown that this mitigation was and—hopefully—is a key enabler to build even more powerful communication technologies—up to the World Wide Web.

We might also reflect on the overall process of evolution. Many species have already disappeared from the scene. However, most of the succeeding species incorporated an enriched system structure and functionality; and all is based on ever-existing forms of living, like bacteria and archaea. It is our task to articulate more facts towards the main reason of our being-in-the-world, and the reason why we have to move towards an open, compositional society. That is, to enrich this world continuously by new opportunities and continuous developments of new ideas and structures.

This holds also true notably for physical theories. Philosophy of science is studying the kind of progress that has been made in physics. Without going into details, it is understood that modern theories explain more phenomena than older ones. A major step has been "the combination of the method of the well-directed experiment with the method of the mathematization of our knowledge about the natural world" ([30], pp. 130, translation GL), as analyzed by the physicist and researcher in the field of philosophy of science, Erhard Scheibe, a student of Carl Friedrich von Weizsäcker. A corresponding aspect is the development of mathematical models, which are used within such theories. Scheibe analyzes this development and comes to the conclusion that after a phase of an isomorphic relationship between a physical theory/its phenomena and the corresponding mathematical model nowadays even more abstract schemes are replacing the isomorphism. That is, based on its decompositional approach, we are confronted nowadays with an evolving number of concurrent theories within physics. It seems that only a new physical compositional perspective could overcome this tendency.

Another core example is the evolution and development of computing systems and their corresponding engineering and scientific methods. A reconstruction of this evolution has to be based on a concept of language. In simplified words, the field of language can be separated into two layers.

The first layer covers all aspects of syntax, and the correlation between speech and acting. This layer delivers the actual or actualized dimension of information. The second layer—the metaphoric structure and use of language—covers the potential or potentialized dimension of information. Deacon's analysis of the missing parts in a common concept of information (he names this missing dimension with the terminus of absence or incompleteness) indicates the causal state of those missing elements [31]. In fact, it is our task to work towards a "completion" (that is: an ongoing structurization) of our world. This is the potentiality, or the potential dimension of information.

The next chapter will summarize the actual development of computers and will point to further potential computing systems. It is generally acknowledged that the usage of computers will continue to grow. One of the current blocking points of new computing systems is the consumption of energy. The next chapter will show—by application of the new concept of information—that new computing systems are becoming visible, which will operate with maximum speed and minimal energy consumption by physical evidence. This is just a simple example, but the path towards the information society requires both a new understanding of the meaning of information and new kinds of computing systems, which will cover the growing need for communication and exchange.

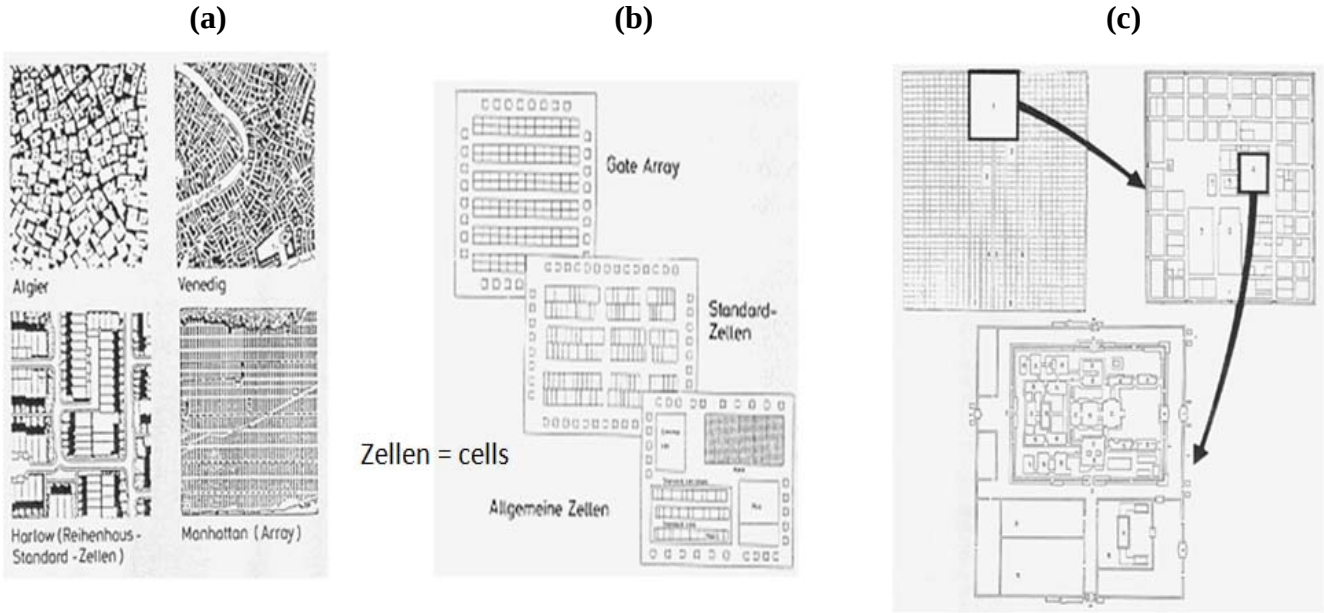
4.2. Information and Computing—towards the Identity of Information and (Dynamic) Structure, and out of a Discouraging Representationalism

The creative process of restructuring the experience is characterized by the newly created links of distributed contexts of knowledge. The cultural framework, the "living world" of people has a considerable influence on the structure of new inventions. In the beginning, writing and sketching was not invented to record poems, but to organize trade. Numbers were invented as bundling or grouping of similar elements (for example a bundling of sheep). Similar bundles were named by phonetic articulations: the invention of numbers. Hierarchies of numbers were invented: bundles of bundles, *etc*. Algebraic systems were invented in order to visualize or to proof different kinds of operations with regards to the activity of bundling and de-bundling. The entire organization of the social system is reflected in those kinds of mathematics. In the beginning, different kinds of numbering were used for different kinds of objects (example: different kinds of numbering for animals, for cereals or for fluids). Even different kinds of number systems were used (for example, Sumerian people used a system to the base of 60; typically, the numbers were also used to interpret more "abstract" entities of the social system: A year for example counted 360 days, which was divided in parts of 60; or the circumference counted three).

The invention of microelectronics also provides good evidence for the transformation of cultural structures ("ways of living") into technical developments. The study of older and newer maps of cities leads us to really striking similarities to microchip layouts. The way social functions are reflected in urban development (for example the structures of dwelling houses, work places, supply and recreation structures), as well as the technician who grows up in such surroundings will most likely use such personal thought patterns in his daily work. Microchips do not just look like cities, they even share a comparable functional structurization (common structural elements for transportation, storage (housing), transformations for specific functionalities).

Therefore, they are made at different places at almost the same time, like the invention of the microprocessor by the American Gilbert P. Hyatt in 1969 and—a little later—by Intel. And it becomes clearer that for example the Japanese culture was able to catch up in the semiconductor industry, even without owning the basic patents. Figure 2 also shows a city in Japan, including the king's palace. We also have to note that Japan's science and industry success in catching up in microelectronics was part of the democratic development of the country.

Figure 2. Similarities between the architecture of integrated circuits ((**a**) different kinds of city architecture; (**b**) architectures of integrated circuits; (**c**) the king's palace in a city in Japan) and the cultural environment of the engineer (picture from Rüchardt [32], with kind permission).



During the evolution and development of agriculture, the concept of numbers became concrete and familiar enough for counting. However, the first notation systems for periodic (pre-algorithmic) events had already been known since 20,000 BC and earlier. Hunters marked and counted the appearance of animal herds and—correspondingly—the different seasons. One of the first automated calculation systems was Abacus, which appeared in the ancient Babylon in 2400 BC. Indeed, the first automatic machines were invented in terms of wind-mills or water-mills. Such automats (greek *automatos*: self moving) are characterized in the way that humans do not directly influence the machine cycle anymore. People remain more and more on an indirect supporting and control level. In fact, this is the birth of *information processing* machines (in terms that users have to work with an abstract transformational/informational model of such machines). Consequently, Muslim engineers developed the first programmable machines, such as the programmable flute player. The application of more flexible algorithms to computing devices pointed to a next step of modern, symbolic oriented computing machines. Gottfried Wilhelm Leibniz invented the binary system and argued for a unity in thinking and acting—a precursor and enabler of real information processing systems. It is not surprising that he also proposed the usage of empirical databases—the world wide web of the 17th century.

It took slightly more than another decade in order to invent the first programmable computer. Konrad Zuse's Z1 was still a mechanical computer and was built in 1935–1938. It had already all the

basic ingredients of modern computing systems, using the binary system. Zuse's 1936 patent application (Z23139/GMD Nr. 005/021) also suggests a *von Neumann* architecture (re-invented in 1945) with a program and data modifiable in storage. This was the invention of symbolic machines: The world of symbols and their possible transformations characterizes the concept of well-specified, *actual* information. Within this world of engineering, Claude Shannon gave a first proposal for a concept of information. But Shannon's theory of information remained a concept for technically communicating systems and could not be used in order to understand semantics or model semantic-based systems (see Part I of this study). Consequently, the declaration of the content of any message or information seems to be a unique property of human thinking: "Compters process data, not information", as the German-Austrian computer scientist Peter Rechenberg judged ([33], translation GL). But we can now give a more precise description of the scenario. We have to argue that the potential dimension of information (in terms of stimulated through received messages) is bound to the receiver and her or his specific capabilities and history. But the lower level or framing parts of any information hold a common and actual content. That is, computers may correctly transform (structures of) actual information. This will be shown in more detail.

The lack of knowledge about this potential dimension of information led to the common (mis-)understanding that the category of information is consequently bound to the subjective dimension of human beings, which cannot be characterized by a physical and compositional concept of information. And for this reason, not all information can be transformed or realized through physical structures. From a pragmatic perspective, the von Neumann architecture is used to implement many different kinds of algorithms. And these algorithms are somehow aligned to human practice; they lack a common physical description, which would support a systematic translation of software-oriented algorithmicity into hardware-oriented structures. Finally, for this intrinsic reason, the domain of computer science is subsequently divided into two different communities: the software community and the hardware community. Those communities follow somewhat different and separated agendas. The software community deals with topics like the logic of programming, structural programming, or object orientation. The hardware community follows the so-called Moore's law, which indicates that the number of transistors (or the number of capacitors) on an integrated circuit doubles approximately every two years. Consequently, there is a seemingly unbridgeable gap between the approach of designing computer hardware and the approach of designing computer software. In other words: It is not possible to transform an informational software concept into an adequate physical hardware structure. Of course there are approaches from the perspective of engineering. But there is not yet a continuous informational concept.

There is another aspect to be considered. There are considerable efforts to build a computing system with the size and structure of a brain. They are based on so-called neuromorphic processors and "aim to understand information processing in the brain at different scales ranging from individual neurons to whole functional brain areas" [34]. Those activities indicate a third community of computing system designers. This community supports the idea that information and information processing can be based on a physical fundament. But such an artificial neuromorphic brain would consume up to 10 megawatts of power (which is equivalent to the power consumption of a city). It has already been mentioned that power consumption in computing is becoming a crucial point. The worldwide CO_2 emission of all computing devices has already passed the CO_2 emission of the worldwide air

traffic [35]. There are quite a lot of activities to reduce the required power, which are entitled “green computing”. But those activities have already been taken into account the calculated 10 megawatts of power for an artificial brain.

Those entire problems lead to a crucial point of culmination. How could it be possible to overcome those problems? What would be a path forward to support the further development of the information society? An answer to those questions has already been given by the German engineer and computer scientist Karl Steinbuch (1917–2005). He introduced and used the terminus of “information” in a quite similar manner as outlined in this study: “The human mind’s task is to receive, to process and to store information. It is seemingly implausible that brain functions cannot be explained by methods and data.” ([36], translation GL) His 1961 book (Machine and Man [36]) is an example that a modern concept of information has to be based not only on engineering design or physics, but also on anthropology and human sciences. The intent of his book is twofold: Starting from a description of new computing devices and their physical foundation, he then introduces a concept of human information processing and discusses the influence of computing systems on the society.

In his book he already described an invention of artificial neural networks, which he called “learning matrices”. Steinbuch solved some fundamental problems of the so-called “Perceptron”, which was invented by Frank Rosenblatt in 1958 [37]. Apart from the known diode Steinbuch integrated other elements with configurable and non-linear response curves in his system. However, his basic progress relies on the design of a multi-layered system instead of the one-layer perceptron. He published his ideas in the IEE Transaction on Electronic Computers in 1963, together with U.A.W. Piske [38].

Steinbuch’s work was not well-known in the US, and for this reason Minsky and Papert came to their negative judgment on artificial neural nets in 1969 [39]. This book had an overwhelming influence and stopped the research activities in the domain of artificial neural networks for more than one decade.

Besides the successful re-established work on artificial neural networks during the last years, there is another basic structural outcome: This is the concept of associative memory and associative computing. It is of high interest that applications of this approach have been made in the field of Databases and Image Processing [40]. Especially Database systems, which are used for large-scale Information Retrieval systems like those of Google, are major consumers of energy. Research activities have been made in the US by the University of Berkeley and the Kent State University. Jerry Potter and others developed an “Associative Computing Paradigm” [41]. The base concept is a method to directly access data by its content, rather than by an artificially calculated address (as it is usually done in commercial database systems). Jerry Potter’s solution is that each data item, which needs to be retrieved, is stored separately and managed by cells. Each cell consists of a Processing element (PE) and a local Memory. The memory of an associative computer consists of an array of cells. Each PE can only access the memory of its own cell. There should be more cells than data. During data retrieval, a search item is handed over to all cells in parallel (“associative search” [41]). Each PE of each cell executes in parallel the comparison of the search item and the content of the memory of each cell. As a result, each PE propagates logical information, using one or few bits. For example, the PE propagates bit information of “1”, if the comparison was successful (and correspondingly a value of “0”, if the comparison was not successful). Given this scheme, a parallelized search can be implemented. In a next step, further processing of the results can take place.

The complete data of the identified cells could be red, and other things (grouping, merging, *etc*.) could take place. PE's are typically made of 8-bit processing units, which perform the required operation. The team described in [40] the structure and functioning of a newly developed 8-bit associative RISC processor, supporting 36 PE's. Finally it has to be noted that those implementations are based on adaptations of the von Neumann architecture. And they still implement and execute a SEARCH function to retrieve data, whereas a FIND function would be required. Such a data FIND function has already been proposed by Steinbuch's learning matrices. We may recall that Steinbuch reported already in 1961 the problem of energy consumption and explored the possibility of saving energy in comparison to von-Neumann implementations, if more hardware-oriented concepts of associative mechanisms were used (*i.e.*, his learning matrices, [38]).

Now, taking all those activities into account: Which structural gap does still exist which hinders or slows down the required progress towards more efficient systems? Karl Steinbuch already talked about a required physical foundation of a concept of information and proposed an extension of Shannon's concept of information. He claimed that the structure of the receiver and his environment (living world) has to be considered as well. There are two blocking points that need to be overcome:

Blocking Point 1: The paradigm of the probabilistic base of information;
Blocking Point 2: The paradigm, that any information is only and ultimately bound to subjects.

Steinbuch's proposed extension of Shannon's information concept notably attacked Blocking Point 1. His solutions and examples at least with a first approximation rely on the physical structure of the objects, which have to be processed. For example, for pattern recognition, Steinbuch claims that a learning matrix has to be designed in a way that invariant characteristics of the objects to be recognized have to be implemented within the structure of the learning matrix. But the "probabilistic spirit" of the task of pattern recognition somehow remains and he could not drill it down to an overall physical fundament. In the end, this probabilistic base of information processing dominates the scene up to now. On the other hand, semantic data analysis and systems design is a very important issue in computer science (as keywords like the *semantic web* or *domain ontology in computing* might indicate). That is, there seems to be a level of the world, which is common to all people and which should be describable in a semantic-physical manner.

Blocking Point 2 is a legacy of the somehow dominating philosophy of representationalism; but is also a consequence of Blocking Point 1. In simple words, we usually think that the world we see in conscious experience is not the real world itself, but a miniature form of replication of that world in an internal representation. Consequently, those internal forms of representation are primarily bound to the subject itself and cannot by physically captured. We may recall the statement of Rechenberg: "Computers process data, not information." Peter Rechenberg is a well known scientist in informatics and computer science. His position is holding a paradigmatic character: It is the outcome of a nowadays dominating representationalism, or subjectivism. If we accept this position then there does not exist a path to physically structure our perceptions and thoughts—not even theoretically. The philosopher Erwin Tegtmeier analyzed the roots of this position. Initially developed by Descartes, "re-presentations" are the way how the mind develops mental states. Descartes considered a causal and similar relation between representation and object. Bu then the importance of the role of (physical)

causality gets more and more lost. “The main difficulty of representationalism concerns the relation between representation and object. Descartes and his disciples consider causation and similarity. With respect to the knowledge of physical objects Descartes rules out similarity because he takes the mental and the physical to be radically different. He assumes a causal transaction between the physical object and certain semi-physical entities in the mind. But the causal chain from object to mind seemed neither to him nor to the Cartesians a satisfactory candidate for the basic cognitive relation. The latter remained a mystery and that created scepticism.” ([42], pp. 78) Kant was right when he mentioned that humans are capable to create and initiate new causally active chains of events [28]. But Tegtmeier than shows that “Kant dissolves the realism problem by turning physical into mental objects and non-mental objects into unknowables” ([42], pp. 79), which indeed “is absurd” (ibd.). Tegmeier then concludes, that this influence is still dominating modern philosophy.

This influence is indeed of high risky and danger, because it hinders us towards liable and responsible acting and thinking. Pragmatism (linking of practice and theory) seems to be a valuable way out. But it neither offers a satisfactory solution, because it misses a physical foundation. Tegtmeier found a solution in Brentano’s analysis of the relations of objects with respect to intentionality. To summarize, Brentano’s and Frege’s works are predecessors for the proposed concept of information. But—besides the logical analysis of those problems—I am very much concerned of this topic, because this representationalist (or idealist) way of thinking adds an unnecessary amount of arbitrariness to the wholeness of our (moral) stance. It causes a vacuum which becomes successively filled by an avoidable egocentrism. If we organize our acting towards a growing structurization (in terms of an enriching phase space) we will save energy in a physical and non-metaphoric sense. This indeed indicates an inherent towards the information society. To sum up, this false subjectivism has to be unmasked as the root blocking point for the design of new computing systems.

The escape route is to replace the representationalist position by the position of (structural) identity, as initially developed by Gottlob Frege (see Part I of this study). Of course it has to be mentioned that such an approach requires much more conceptual elaboration. However, as nature has already developed such an approach—it seems to be our task to rely on this concept.

This state needs to be highlighted. It has to become clear that the common representationalism—this bondage and ligation to the dimension of an absolute and therefore non-natural subjectivity—deeply discourages and demotivates an approach towards a physically oriented computing science. It does even shed a discouraging light towards the movement to the information society. And it does explicitly steal the possibility to design computing systems, which operate with minimum energy and offer maximum performance at the same time; and are based on a physical foundation. Theoretically, the incoming signals to a computing device may already contain the amount of energy, which is required to fulfill the intended computing task. The escape route was already indicated in Part I of this study, when it was explained (initially shown by Charles H. Bennett) that any computing program could be implemented in terms of a reversible system. Some kinds of “billiard computers” have been designed in order to visualize and validate this approach. The program would exist of billiard balls, surrounded by certain specific and stable bars and reflectors. An initial throw of a billiard ball would already contain the required energy and transfer this energy and movement to all other balls, which would collide. Finally all balls would carry an ending position. This ending position equals the result of such

reversible computation. Theoretically, the energy brought to the system may finally leave the system, so that the overall energy consumption would be zero.

The maximum speed of such a computing process can be achieved if the degree of parallelization is maximized. Within a physical framework, a system of highest parallelization is a linear system. That is, input entities point in an explicit manner to output entities. Furthermore, many input entities can be overlaid at the same time. This is the basis of quantum mechanics, and the reader might also think about quantum computing systems. In fact, we will now work towards such highly parallelized computing systems, which simulate the behavior of real quantum systems. This is done by an application of the proposed concept of information. It will be shown that the content of any informational transformation is laid down within the overall system structure. This overall system structure defines the concept of identity of such systems. That is, any incoming signal in such a new computing device will not cause the activation of somehow arbitrarily defined algorithms, but will automatically FIND the place (=address) of its value and thereby activate all further data, which is bound to its content. We will proceed in two steps. In a first step, we will expand on such computing capabilities with regard to linear physical systems. The second step expands on the transformation of physical computing systems to digital computing devices.

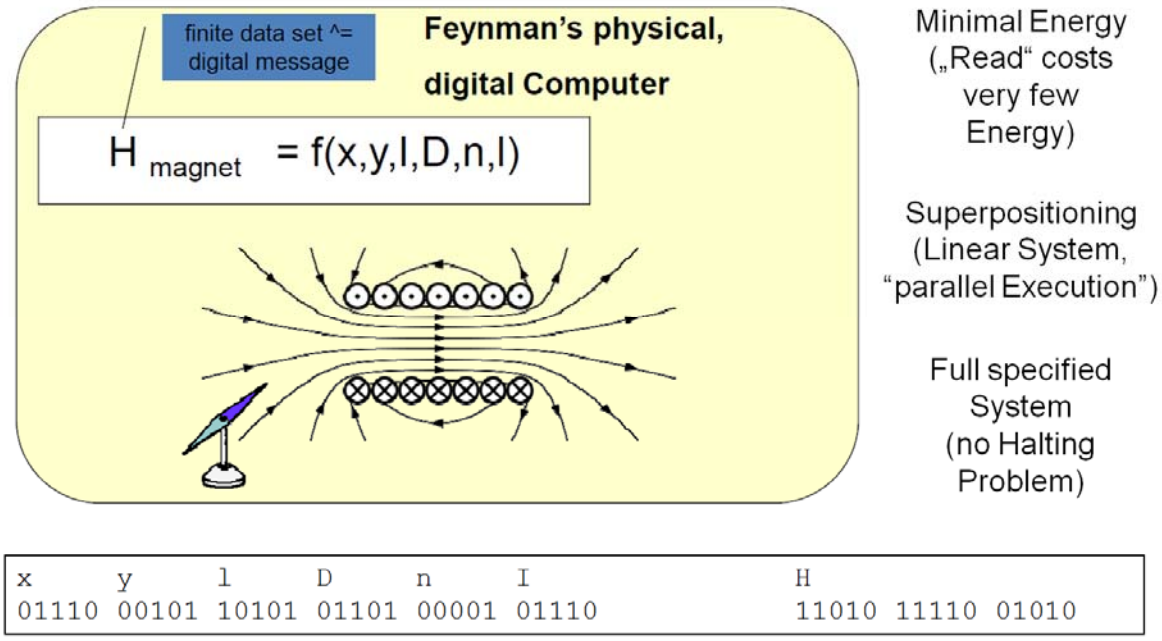
First Step: We need to integrate some thoughts of the physicist Richard Feynman. He claimed that nature has the potentiality to compute and that already something like a magnet can be called a computing device. The identity of the magnetic field is given by a physical transformation (the "formula" or the "code"). For any point in the space, such a formula calculates the magnetic force. The heart of a new computing concept is that this magnet itself creates *in advance* any information, which could be retrieved later by a user. The formula is executed once, and the information is stored by such a computing device. Any user will then directly access the kind of information of interest, without the need to execute complex algorithms and dissipate huge amounts of energy. The next figure illustrates an example (Figure 3). Feynman gave another argument towards a broad and comprehensive physical foundation of such a computing system. He argues that the world is made of quanta, and all quanta are countable. He concludes that in a next step all parameters, which are contained by the formula are fully and sufficiently digitizable. That is, there exists a comprehensive physical foundation on which to build digital, physical computing systems. And it is a fully parallelized system, like those proposed by Steinbuch.

Such kinds of ideas were already introduced by Konrad Zuse. In his book "Calculating Space", Zuse explored a first vision of digital physics [43]. He explained that the entire universe could be conceptualized as a computing machine, and he argued for a physical basis of such a concept. Similar ideas were promoted in the US by Ed Franklin. But they did not yet include explicitly the idea of a potential dimension of information in his thoughts. Nevertheless, a first step in this new direction is the kind of physical computing system, which has been mentioned by Richard Feynman in one of his speeches [44]. And one of his examples holds the identity of "structure" and "meaning", which is the entry point for the design of computing systems, which are based on the concept of structural identities rather than on a mere heuristic concept of algorithmic approximation.

Figure 3 shows an electromagnet, which is made by an electrical coil (the wires of the coil have been cut off in the drawing: this sign ⊙ indicates a cut off wire, where the electrons move towards the reader; this sign ⊗ marks the contrary case: the electrons move into the surface of the drawing). "H" is the sign for the magnetic force; *x*, *y* are coordinates, which identify each single point of the magnetic

field; I is the amperage; D is the diameter of the coil; n is the number of convolutions of the wire; and l is the length of the coil. There is one magnetic needle drawn in the figure, which may indicate for any given position *x*, *y* the direction of the magnetic field H. The reader may note that many such needles could be operated in parallel. We might also imagine that such needles consume very little energy. In facts, they consume zero energy, if they are once brought towards the direction of the magnetic field. Their consumption of energy is only given by the friction, which is forced by the needle during its movement.

Figure 3. A digital, physical computing system.



Now we can setup a vector, which totally covers this physical system. At first we have to analyze the number of binary digits, which are required in order to represent each of those parameters. We have already mentioned that this number must be finite. In our example we represent each number by the usage of five binary digits. Then we have to concatenate (to line up) all parameters into one single vector. Then, ultimately, we have to consequently permutate this vector from its initial value:

00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00001
00000 00000 00000 00000 00000 00010
…

To its ending and last value:

11111 11111 11111 11111 11111 11111

Then, in the last step, we have to associate the value of the magnet field H to each line of the vector. This is done in Figure 3 for one single line as an example. Once all associations have been done, the new physical computing system is ready for operation. We may now ask for the value of H for one

single line of the vector. Or we may ask for a couple of different lines. Or we may even ask for unary fields within this vector: maybe for all lines between the following lines:

Starting line:	00001 11010 11100 00011 01010 00111
The next line would be:	00001 11010 11100 00011 01010 01000
…:	…
Last line:	00011 00000 00000 00000 00000 00000

All those lines could be activated in one single step, and all corresponding values of the magnetic force H could be red in one step. We have also to underline that all those vectors hold a unary order. That is, we can always very simply post a data retrieval command for an "in between" qualifier. This is a very important structural characteristic and opens the path towards a semantic interpretation of any kind of interrogation of such kind of vectors. In fact, the "semantic interpretation" of this scenario is nothing else than the consistent definition of physical law or regularity, which is given by the transformation of the vector. That is, as long as physics is consistent, any such kind of transformation will hold a semantically well-defined structure and meaning. Let us summarize:

(1) The system operates with a minimal amount of energy (which is maybe already given by the impetus of the incoming signals);
(2) The system holds a unary order;
(3) Many interrogations of the system can be done in parallel;
(4) To sum up, the system holds the characteristics of a quantum computer.

The reader might already imagine that such kinds of systems hold a preferable structure with regard to computing tasks, which are characterized by an important amount of data read activity (that is, many users access huge amounts of data; Google might be an example).

Second Step: Transformation of Physical Computing Systems to Digital Computing Systems.

Let us first characterize the different kinds of tasks, which are usually fulfilled by computing systems. In a simplified and general manner we can divide this world into two domains: The first domain includes the systems and programs, which can typically be bought on the market. It also includes the usage of the World Wide Web and any other kind of application, where data is stored by certain data providers, and then this data is read (and maybe updated) by users. The second domain covers the creation and execution of sophisticated and maybe large programs, like weather forecasting, or any kind of scientific calculation. The second domain is characterized by few users and few repetition cycles of such programs (nevertheless, the results may be propagated to the www or other databases). The first domain's characteristics are a big—or even huge—number of users or readers and a huge amount of execution of the same software. As an example, the reader might think of the usage of data providing systems like Google. Many users may access those systems (maybe simultaneously) and search for data. All those search processes are now executed in a huge amount of numbers, which costs huge amounts of energy. The reader might already imagine that it is worthwhile to transform this domain into a structure, so that energy savings could be addressed from within a sustainable and structural level.

Applications like those of Google spread all their data into huge computer farms. Google may nowadays operate hundreds of thousands of computing nodes. If you send a question to the Google

search engine, many sophisticated algorithms are executed in order to find the required location of your query (data center) and to finally retrieve your data. During this process, thousands of computer nodes will dissipate huge amounts of energy, because each interim result of all those algorithms has to be stored. This process of storing a huge amount of interim data (of which the user has no idea) costs energy and time. Google has successfully developed very fast algorithms, which on the other hand use huge amounts of hardware. A simple calculation shows that more than hundred millions of dollars are required in order to pay the fee for electrical power per year.

A new computing architecture may help to overcome such problems. This concept permits retrieving any required data with a few steps (instead of hundreds of steps). A concept of semantics will be introduced from the beginning: This concept is built on the identity of any data in terms of "meaning" and "storage address" by using what we have called a code. Let us look at an example: A list of names and some additional information. Using our language, we want to store all kinds of words, which are made of letters. Let us use a code, which exists of five bit in order to decode a single letter. We may decode up to 36 letters, which includes all letters of the alphabet. The letter "A" might be represented by the bit-pattern "00001". The name "TURING" is given by following pattern:

"10100 10101 10010 01001 01110 00111"

In a next step we may store any other kind of data at this address (*i.e.*, first name, birth date, telephone, email-address, *etc*.). The decoded message is identical to its address within the computing device. We conceptualize an identity between the meaning of any message to the user and its address in the computer. This approach gives the name to this concept: iBIT = identity Based Information Transformation. A basic example of this concept has already been defined; it incorporates a set of reversible transformations, which do not require the usage of a CPU [45]. The iBIT concept has also been developed for a pattern recognition application. A prototype of an iBIT system has already successfully been tested in microelectronics production. The core of this concept is a non-probabilistic, non-CPU.based system, which automatically identifies so-called semiconductor wafers. Such wafers are made of monocrystalline silicon substrates and show very intensive and challenging light reflection characteristics. They look like metallic mirrors and change their color and reflectivity during the production process quite intensively. This new iBIT architecture has the structure of a quantum computer: Many simultaneous input patterns (vectors) may overlay at the same time and deliver synchronously required output data.

The usage of codes is nothing new in computing science. What is new is the approach to identify the identity of any language area (*Sprachraum*) by the analysis of the coding (with regard to the usage of phonemes and morphemes). By using the coding scheme, any language expression will be positioned within the Sprachraum by a codified transformation of the atomic elements (phonemes) into a digital representation. This digital representation serves as the identity of content/meaning and address of any language expression within the Sprachraum. There are many applications known to calculate storage locations for data items (hashing, binary trees, *etc*.). Database systems execute sophisticated algorithms in order to calculate the storage location for different kinds of data. However, all those mechanisms are driven by a process (an algorithm). The proposed solution does not use any algorithm, but enables the transformation of the content of a data (sequence of phonemes) into an appropriate location place within one or few steps. For this reason, any algorithmic search process will

be replaced by a direct find process. Also similarly looking applications (like CAM: Content-addressable Memory) implement a search process (algorithm) in order to retrieve certain data. We have posted a patent application for this new approach in computing. Another outcome of this approach is the elimination of the halting problem. Alan Turing has shown that it is not possible to predict if a computer program will once stop. As a conclusion, each program has to be validated and tested separately and very intensively. However, those classical computer programs are implemented on computers with a von Neumann architecture (every von Neumann architecture implements the Turing machine). The new concept does not implement the Turing machine, but a linear vector space. Within a linear space only linear, vector transformations are defined; consequently there exists no Halting problem.

Three research projects have been started in order to explore and develop the iBIT concept at Technical University Dresden, Germany. The scientific goal of this project is to deliver a conceptual framework, which enables the design of new computing systems, which comprise maximum performance and minimum energy consumption.

5. Towards a Compositional Self and a New Ethical Spirit

5.1. Unification, Diversification and the Bar-Hillel-Carnap Paradox

People tend to charge identical words with different/personal meanings, create metaphoric contents, *etc*. But things also need to be inter-personally explained, especially for words and symbols with regard to their relationship to the external, inter-personally organized world. Zipf assumed two different forces: unification and diversification [46]. Unification stands for the system-centered perspective and organization of activities. Following the principle of least effort, one does not really bother about the identity of other people. One also uses identical words for many purposes (like homonyms), and the personal style of using specific words becomes important. The disadvantage of this strategy is a very stereotypic behavior in terms of thinking, speaking and acting. While the amount of invested energy is minimized, the success is very limited with respect to changing boundary conditions (but maximized for a given set of boundary conditions). Only one possible path is worked out and enforced. That is according to the principle of least effort. Such centralized-hierarchical control systems may work very successfully. The central control instance defines the words and actions as kinds of "order" ("order" has also two very interesting different meanings: First, an "order" is a command order to a soldier—that is the pragmatic dimension; second, an "order" is a system of how to organize a set of artifacts within a well-defined manner or rule). The relevant controlled subunits accept those messages and perform them accordingly. In terms of effort, a minimal amount of meaning (or kinds of action) will be instantiated by a minimal number of words. Communication consists of "command and accept structures", without any further discussion.

The concept of diversification acts as a counterforce within this scenario. The number of words may increase. While accepting an enlarged set of boundary conditions, a couple of concurrently existing overall action schemes may be required in order to maximize entropy. In order to accept an enlarged set of boundary conditions, the individuals have to exchange further information and have to invent step-by-step what we call open discussion and talk. This is one of the main forces leading to the

introduction of syntax: The usage of syntax itself reduced the number of words in order to identify a specific activity. Noam Chomsky discovered the structure of all syntax: Each meaningful articulation is built on the noun-verb structure. The verb identifies the system's internal perspective (the kind of activity to be done) and the noun identifies the external perspective (the subject of the activity). Our freedom is identical to the ability to restructure our activities within this universe and so to create new physical/transformations, which in turn open up new phase spaces.

Through the identity of system/noun/sound and content/meaning/state language enables a dynamic potential of creating new physical rules/transformations, because such a language may anticipate/simulate further development of a "self". The mind holds a description of the system, and this description includes an isomorphic kernel, an identity to (physical) structures of the world. That is, for example, our schemata, which describe body movement are isomorphic to the corresponding physical laws, though such schemata exist of well-defined linear transformations. This is a direct, one-stage identity. Phonetic movements (articulations) hold a similar, but two- or more-staged identity. Those are expressing relationships and laws, where the body only indirectly participates. In the end, such expressions deal with objectified cases of the world. Those cases play part within the overall causal and physical (chemical, biological, …) framework of the world. And as such expressions are identical to structures and laws within the causal framework of the world, they hold a causal state by fundamental evidence. We can now translate Zipf's concept of unification and diversification into our approach: unification stands for simple information transformation. This concept guarantees the functionality of a well-established set of actions. Diversification stands for further composition of further information/learning and storage. This deals with the development of new sets of transformations in order to facilitate accessibility of new phase spaces.

The next step indicates the process and causal reason for change. If we transform this process into language, then such a process is expressed by the question: "Am I right?" This question indicates the process and motivation for change and for any further development of the self. A more literary description, but one, which includes a sparkling logical amplification is the statement of Epimenides (a Cretan): "All Cretans are liars." This statement becomes a paradox, if Epimenides himself is saying this as a Cretan. If Epimenides is telling the truth, then he is saying that he is really lying. So he cannot tell the truth. There are a couple of solutions for this problem, notably Alfred Tarski gave a consistent solution: He proposed that such statements could not be a valid declarative sentence [47]. But it incorporates nevertheless a certain—and very important—kind of information. Usually you are not really bothered about your thoughts. But this may change, if you start thinking: "Am I really right?" That is once more Epimenides' question. It is the question from where all thinking starts. That is, such a statement is not only an innovative metaphor, but also displays the logical foundation of any self-development. The sentence "I am a liar" indicates the "readiness" to move towards a restructuration of the knowledge basis (a knowledge-based system holds the structure of a two- or more-staged identity of schemata (*i.e.*, objectified articulations)). It is not the point that Epimenides somehow found some inconsistencies within his knowledge. This sentence is just the articulated expression of the included middle: Any system is always open for further development, including the change of major characteristics of the self. We are creating more complex sentences and statements, because we are deeply using the capability of restructuration. Any sentence, even a declarative, non-emotional phrase, questions the self for further change and development.

The reader may recall the Bar-Hillel-Carnap paradox within this context. This paradox appears by applying Shannon's information concept to classical semantics. The amount of semantic information carried by a proposition (or signifier) p is directly coupled to its unpredictability. This paradox says that (within the Shannon concept of information) "the probability of a received message p is actually zero, that is, p is impossible or equivalent to a contradiction..., p should be maximally informative" ([48], pp. 58). The semantic information of a fact well-known by the receiver is close to zero. If you are a brown haired human being and somebody tells you: "You have brown hair", the probability of p of this proposition is one and the unpredictability is zero. But what if somebody (who maybe has more significant information about your person) tells you: "Your ability to understand and support people is so much higher than your current job as a software engineer requires. You should think about changing your profession and maybe become a teacher or work in a medical area." If you have not seriously thought about this, the probability of such a proposition is close to zero. The paradox can be solved, if we recall that a single proposition or signifier does not contain information by itself. The information is given by the structural law, by the basic behavior rule/rule of thinking of the receiver. The solution of the paradox proposes that a message or signifier, which activates maximum information, may change the fundaments of the person. In short, such a person may change him- or herself, like Epimenides maybe was envisaging.

But this is the "human" resolution of the paradox, not the logical one. The logical one is even reinforced: We are living through compositional paradoxes. However, new configurations have to be validated and stabilized from within an overall context. For example, the main change towards an open, democratic orientation within a society requires active responsibility of their members. The persons who are dominated by control hold a more passive potential to act with regard to the control system: They are merely reacting instead of acting. This has to change fundamentally with regard to further democratization. While on the one hand—from within a mere passive perspective—one might complain against impersonal hierarchical control—the same person will be thrown into a situation which requires active responsibility and cooperation with others. Of course this does not happen in one single step. But we may compare this situation with the development and evolution of language. This only succeeded, because the members of a society started to articulate their different standpoints and opinions.

5.2. Towards a Compositional Self

Are those assumptions and conclusions not too speculative? And even more—is the reduction of the human spirit to a seemingly non-logical field not too vague? Indeed, it seems that we should not overlook the forces, which come from standard logical thinking with its avoidance of contradictions. However, in what way do our own motivations look alike? Maybe the reader could imagine how it is to be in love. When we fall in love, many contradictory feelings merge within our conscious experience: desire–fear, shyness–impatience, adoration–sensuality. And all occur (more or less) at the same time. In a more restricted manner this holds also true for artwork or scientific work. However if so, then there is always a risk, there is incompleteness. However in the end—this is the hope—a bit of success will extend and enforce our own being. Indeed, by falling in love we are willing to dynamize our self towards a significant openness to the future. The aim of this paper is to expand on the topic

that there exists a natural force, which helps this hope to become reality. Nature gives us the power. Conscious systems have exclusive access to those compositions, which enable entry points to new, enriched phase spaces.

Language as a syntactic encoding machine for generating a symbolic operation level intensifies the power of this cognitive system by multiplicative factors. Whereas the anthropological roots of the concept of truth can be found again in that phenomenally experiential "sudden insight", the logical level of this concept follows on from the achievement of an abstraction which can only be explained against the background of the symbolic-verbal, sign-orientated social co-existence. The concept of truth is an outcome of the mind process having to co-ordinate the conceptions of the world with each other in the social context, which is reflected in it. In rigid social systems, this problem does not exist. Therefore, the way to the genesis of our concept of truth can be smoothed only by creating an open social system. The invention of democracy is the adequate solution in order to use all people's knowledge and skills. This can be shown in terms of the evolution of social control systems from strictly hierarchical, top-down organized systems (like military control systems) to more bottom-up oriented, democratic structures. Remember the roots of the Indo-Germanic term "magh": This is the root form for "machine" as well as the German "Macht" ("power").

The elementary structure of the complex social process of creating an open social system is based on the fact that by generating socially open interactions, the transformation takes place from the object-like thinking to the process-like modeling of social structures and, therefore, to the construction of the individual self. It is with the invention of the script (once used as an accounting system for the organization of bartering, counting and trading) and critical discussion, speech, that mankind started its journey from the timeless primeval times to the historically modern times: From this time on, mankind as well as every individual has a historical biography. Man as an open system can fulfill himself in an open society in a greater way. Karl Popper introduced the concept of an open society [49]. He found the following pillars of an open society: personal responsibility and development, free discussion and labor, open schools, free establishment of personal relationships.

What we perceive as freedom is an ongoing process of maximization of the number of system states. But the required phase spaces have to be created and actively stored. The moment of freedom is the moment of storage of such new information as a new transformation rule. As this information may have the potential to modify our self—that is, a superior level gives specific focus to inferior levels—it is inevitable that such a transformational situation itself generates the phenomenon of what we call the *now*. This is because the experience of *now* indicates the future in terms of giving certain possibilities to certain transformations of the entire system at this single point of experience. The outcomes of those simulated transformations are stored in a temporal storage in order to enable the capability of creating alternative action schemes. Nature, so to speak, gives us the task to create as many alternative action schemes as possible, and thereby enable the fundamental category of freedom. This is the concept of unity in multiplicity (Immanuel Kant, Wilhelm V. Humboldt). In fact, unity and multiplicity are contradictive concepts, but are logically necessarily partners (Brenner [11]). We act responsibly if we do not just react, but if we continuously create new opportunities and enrich our world. This does not mean starting numerous actions without proper planning. Nor is the intention to rely on a simple freelancer-attitude, which is primary driven by changing labor conditions. The goal is to reinforce our capability to act through the knowledge of the forces, which are enabled by engaged conversation and

personal commitment. This will enforce personal identity and authenticity—basic preconditions for gaining further confidence and trust.

However, information technology itself does not lead to an increase of human values. On the contrary: We are facing massively growing offers regarding information consumption (e.g., massive growth of online advertisement).

Information technology and applications have bypassed traditional industries like automotive, aircraft and others in value. Facts, stock markets, crisis, computers, www, wars, strikes, market figures, all kinds of "information" is dominating the headlines. We are consuming such information and our behavior is well analyzed and understood by market specialists. For such an approach, a simple input-output-behavior is the best control and the subject of certain kinds of advertisement. Such advertisement does not have the objective of making us think, but to push us towards consumption. Following the impetus of such advertisement, we should avoid any kind of further thinking and reflection cycles (it is worth mentioning that some of our market specialists have for good reason changed their opinion; see www.adbusters.org [50]). Another example is television. Sociologists like Pierre Bourdieu analyzed the mechanisms of television, which aims to satisfy the craving for sensation of the masses [51]. Journalists are reduced to day laborers. Luckily there are many examples showing the contrary. Martin Luther for example used the evolving print media to distribute a translated version of the bible to the common people. Imagine that we could watch all TV channels simultaneously in parallel. Imagine also, that you would have done this forty or fifty years ago. Do you think that today we are better "informed" than we were fifty years ago? There are many forces within the so-called information society, which do not really have the goal to inform people, but rather to earn money as fast as possible. This may even lead to an information collapse. Philosophers such as Mark Burgin, Wu Kun, Luciano Floridi, Joseph Brenner, Wolfgang Hofkirchner and Pedro Marijuan are working towards a unified theory of information, in order to analyze and help overcome such problems. We have to highlight that information really holds a causal, personal state. We have to make clear that unintended, massive advertisement ignores the person as an active force. It should not be denied that information about different kinds of products is important. But we have to make sure that qualitatively good information (including advertisement) takes the active person as the key player.

This socially embedded placement of information has already supported the development of writing and its incredible compositional rules. Writing in the beginning supported different kinds of control activities (to exchange goods), but it stimulated further compositional capabilities in poetry. The same will hold true with regards to computing technologies and their usage within the information society. For example, nobody nowadays imagines anything like a limited amount of resources for writing purposes. However, this is not yet true for computing. Today, the consumption of energy by computing has bypassed the energy consumption of the worldwide air traffic. While the big trades for books do not discuss the technology for book printing, this is not true for the important computing trades. Computing science still has to continue its homework, and has to design computing technologies, which are not outdated already tomorrow. The same holds true for computing programs. We have to create better applications than Avatar or 2nd Life, which on the one hand consume huge amounts of energy and on the other hand decrease the value and development of our self. Applications of social networking still have other kinds of problems, but are doing a better job in this direction. And advertisement will be replaced by concepts of objectified disposability of kinds of information. Of

course people are interested in different kinds of products, but newer systems will give the activity to the user, so that she or he can select different kinds of things (which she/he may find in films and also in educational material) and she or he may navigate from and more objective starting point towards the comparison of different products.

There is another type of question arising. Philosophers like Hermann Lübbe claim that nowadays we are facing a "black wall of the future" [52]. Why do we, in some way, know less about our future than our ancestors? We are certainly living in a constant process of change. Man has changed the entire Earth in the last 300 years to a greater extent than all in all in its three-million-year history. This scenario indicates that the human approach versus unique "objectiveness" is still continuing and that for this reason a personally motivated dynamization of the self is lacking. But the compositional force between objectivity and subjectivity is information. It seems that the "objective world" in terms of campaigns of all kinds of advertisements takes control over our activities. We are controlled by things, by money, by practical constraint and inherent necessities. The social system tends to become systemic, and personal responsibility is decreasing. Companies are becoming impersonal. And if a company fails, nobody is responsible. But as long as it succeeds, management pays well—especially itself. We are confronted with a growing lack of personal authenticity and responsibility.

What does that mean and why is it important to highlight this? Modern, materialistic-/physical-oriented philosophy works towards the project of the elimination of the subject. And the counter-theories are lacking a major physical concept, so they cannot rely on a physically grounded counterforce. This dilemma creates a collapse of orientation and guidance. This paper proposes a physical, causal and compositional concept of information as a conceptual framework in order to articulate and to overcome this dilemma.

It has to be highlighted that there are, of course, immense causal constraints, which influence and somehow predict our activities. These are not just symbolic, but real causal forces. And, as it seems that the subject is eliminated, this attitude gives legality to the movement that advertisement and control strategies are taking over activity and also responsibility. And this movement points towards the paradoxical situation of—at the same time—decreasing authenticity and confidence.

However, there is on the other hand a physical capability towards a power of assertion, which comes out of our objectively singular, but subjectively inherent and communicable demand for information. Which is—in fact—based on a physically implemented framework of fairness and freedom, and which is grounded on personal identity (as "universal singularity"), an upright position, openness and further authenticity. Our personal persuasions and beliefs are the constitutive elements of such an identity. We need the capability to change and develop them. This is, of course, also the entry point of art (Jean Paul Sartre for example saw Jazz music as a form of freedom and authenticity). Within the long run, nature enforces us to develop such an internally mediated identity towards personal authenticity, based on fairly exchanged and developed information (in terms of messages and all kinds of publications as well as the causally and compositionally grounded infosphere).

In short: We need to move away from centralized control systems (within our social environment) and need to enforce personal competence and responsibility. And how should we do this? With commonly exchanged information, of course. Such information may act as a mediator of a newly upcoming (or continuing) Age of Enlightenment.

A main pillar of a social system is its availability of potential activities, which are glued together in a set of rules, which can be named the values or the "morality" of this system. The financial disaster that happened in the last years is based on an abuse of credit and confidence, which had been developed by the society prior to this abuse. During this period, personal responsibility and activity were developed, which enabled the foundations of the modern market: Free exchange of products of well-proved value. Based on this scenario, the "seller" became respected as a person of knowledge (about the quality of his product) and relatively fair rules on pricing and payment were developed. Nowadays so-called bankers discredit and "eat up" those moral values, which have been once attributed to sellers (or owners of a product). That is, we are now confronted with a huge consumption of social morality through an unbalanced capitalization of fairness. And of course: Bankers argued about the "inherent necessity" and the "factual constraints" which pushed them towards such kinds of practices. The dilemma is clear: Based on a deterministic, computational model, people are starting to develop themselves towards monolithic egocentrism and for this reason uncooperative and unfair behavior. The actual financial system uses and acts based on precondition, which cannot be created by such a system: and these preconditions are fairness and open exchange of relevant information. But if the thesis of this paper makes its point, then we are capable to directly access and "feel" the problem, which already incorporates the seed to overcome this situation. The problem is made of a tendency towards huge control structures. And the counterforce is information.

So, how is our moral stance made? We already found and discussed the three pillars ((a) an intuitive feeling for a "good" behavior; (b) our personal persuasions and beliefs; (c) our longing for a fulfilled life), but we have to now investigate the last pillar: our concern for an appropriate respect of the other members of the society, in which we are living.

Typically, we define our self in terms of comparisons to other people. There have been two simple but typical schemes for such comparisons. If I do such a comparison with regard to a morally "better" person, the comparison will deliver a negative feeling towards myself (upward comparison). In contrary to this, a comparison with a morally "worse" person will deliver a "good feeling" and a succeeding further stabilization of my ego (downward comparison). It is worthwhile to note that comparisons of our moral stance hold a holistic character. That is, there might be no bad feeling if we compare, for example, our lacking knowledge of literature with regard to a friend of ours who might be very interested in literature. But this bad feeling might appear, if we come to the conclusion that our moral stance might be worse than that of our friend (which would be demotivating).

The social psychologist Thomas Mussweiler discovered another attitude. He showed that "upward comparisons" might also motivate us [53]. If the person of our comparison is somehow similar to us, then an upward comparison might increase our motivation to become "better". It is important that those persons are similar to us. We might adore persons like Mother Teresa or Martin Luther King, but this would not end up in a further dynamization of our self. Mussweiler's conclusion is that there seems to be no fixed predefined rule, which steers and predicts our comparisons. That is, nature gives us a non-algorithmic capability to strive for further identity and authenticity, and this capability is given within societies. So there is no need to fear moral comparison with others. On the contrary: We will become stimulated to enrich our personal identity and personal values. Again, nature supports us towards fairness and authenticity.

This is the entry point of our causal-compositional concept of information. We are capable of developing and increasing our capabilities, which will lead to (or is caused by) a further enrichment of our overall stance. We have to make clear that we do have direct access to this kind of information, because we can imagine and "simulate" such a further development of our self.

There are interesting examples, which by themselves highlight the values of the open society mentioned above: New kinds of schools, based on activities by parents; taking over responsibility and usage of public places within cities where the government of the city refused to help; many kinds of non-profit activities, which nevertheless create social networks and support and encourage personal development.

Another indicator is that nowadays people smile less. What does that mean? Are we less informed nowadays? Helmuth Plessner has done the most recent profound analysis on this subject (at least to my knowledge) back in the 1950s, and he concludes that while we smile, our mind is ascending to a new kind of overall state [54]; which is an informational state, as we will see. (Brenner has described the recognition of humor as an emergent state at a higher level.) There is a great variety of smiles: the profound, the sad, the happy, the lost, the knowing, the deceiving, the irrational/rational, the irritated/irritating, the open/closed smile, and many more. Smiling is a *prima facie* human principle. No further motor/body activity is coupled to a smile, except the very detailed mimicry and activity of the muscular apparatus of the face. Smiling is an integral, *deeply reflecting* activity. And of course, if you have achieved some kind of new phenomenal insight, your mind gives its best to you; and all that you need to do—is to smile (a "Eureka" may appear as well, but this is very much the exception). Smiling shows the activity and almost *is* the mimicry of the mind, as Plessner stated. And it is—as perceived by others—in sum a positively connoted activity. Because the number of possible states is maximized by this process, smiling people move towards new insights and also maximize their number of possible internal states. That is, we are guided by physical evidence in order to reach for information. And as those physical laws are given to us from the universe, it becomes clear that we are of deeply heterogeneous (and primarily not of autonomous) structure, as Rafael Capurro remarked (note to the author). Does this give rise to further optimism? I would argue that the answer is "yes", if we keep our mind working and moving towards a specific informational structure, which *enriches* our capability to feel, act and think. This may also argue for a new kind of ethics. Typically, ethical rules hold a passive structure ("you should not …"). This needs to be replaced by an active attitude in order to constantly reinvigorate and newly compose ourselves.

In a preceding study, I tried to show that our action horizon nowadays is decreasing, while our technology increases the outcomes and negative effects of this technology [21]. That is in some ways a negation of human culture, and this effect can be seen by studying the evolution of different cultures. One effect characterizes any positive transformation of the situation: That is the increase of personal information. The invention of human communication, up to the invention of democratic rules and the passion to think prior to merely acting, increases the amount of personal information and therefore responsibility (which is the same). While inventing agricultural practices, our ancestors increased their action horizon from months to years. The foundations of smaller, then growing cities are worked out by extending thinking horizons and through information. The saturated self (Gergen [55,56]) appears because the responsibility/action horizon decreases while the availability of (technical) tooling increases (high specialization; this also includes games). As an outcome, the dynamism of a

future-oriented action/thinking organization is lost. Today, typical industrial projects, which last longer than 1–3 years are not doable anymore. The reader may remember that within certain periods for example, some architectural projects took decades or even centuries. Without judging the goals of such projects, it is clear that a major pillar of those projects has always been the art of planning for such an amount of time (even if this planning process was mostly implicitly given). A certain kind of stability and responsibility for the future has therefore automatically been created. Succinctly, the balance between static/ego-centric and dynamic, verb-oriented thinking (including our social environment) has to be re-established again.

What about art? You may already have an idea about the following kind of answer—the field has been prepared. "A good poem adds something to our world, which has not been there before." This was the response of the German poet Reiner Kunze during a lecture at Radebeul in May 2008. He was asked about his criterion, which characterizes a good poem. Our activity in creating and using artifacts from art (literature, music, painting, *etc*.) is the precursor in order to develop new phase spaces. Perhaps the reader has already perceived such a step towards unknown dimensions of experience while hearing or celebrating music. Good art can be interpreted in innumerable ways. That is the reason why we may enjoy really good pieces of music as many times as we want (see Beierwaltes for further discussions of the subject [57]). Our influence on any future world starts with our daily life: If we create new opportunities, we will increase the number of possible states of such a universe. And that is the precondition for further reflections. We perceive a specific judgment of such a state of reflection, because such a state has a positive connotation through some kind of natural law. This is one of the reasons why smiling transports such a positive connotation, because smiling indicates the state of reflection and creation of new insights and models. We are doing things right if we make people smile. If we do so, the potential information of the universe will be maximized, offering itself a maximum number of potential activities. This is meant as an anthropological argument towards a common and enriched future, and not as an expression of kinds of "new age literature".

This idea automatically leads to a non-normative approach in ethics. Typically, ethical questions are about normative rules. But this does not represent the initial human impetus, which covers the attitude to gather an overview (walk upright), to move in the right direction and to take actively required decisions. The "right" behavior comes out of an upright position, and to gather overview is the precursor for freedom. The proposed concept of information promotes simple and clear measures for any "right" behavior. Such kind of behavior always increases the capability for acting and knowing. It expresses itself through acting, through verbs, and includes further developments of any of us. "Wrong" acting always ignores existing knowledge. The universe has given us the task to overcome the limits of gene-controlled, unconscious activities. For this reason, the universe has laid down the preconditions for compositions of informational singularities—conscious acting, feeling, thinking, failing, learning entities. Our naturally given task is to enrich informational structures within this world, to move towards an active ethical approach and spirit.

Based on a deterministic and algorithmic anthropology we tend to think and act in terms of a static, monolithic, ego-centered view. We have to care more about our own role and kinds of activities, which are required to change and evolve our behavior. To put it another way: The classical information scenario centers on "objective interests" of receivers and does not take into account the subjective perspective of personal development. The new concept of information may help to overcome this

heritage. If things are doing well, our repository of possible actions will increase and we may access new regions of phase space. We should:

(1) Maximize *understood* communication;
(2) Practice fairness;
(3) Maximize our fields of experience (changing/enriching our profession);
(4) Enable a multi-perspective, not centralized knowledge philosophy and structure.

The gross domestic product (GDP)—and especially its growth—is often considered an indicator of a country's standard of living. This study argues for a new indicator, which offers a huge potential for further growth and healthiness: We call this indicator information.

While we are smiling—the universe *itself* is smiling within this point of informational singularity. There is a natural reason to approach happiness within life (in the spirit of Aristotle). But this includes all people and living species. It is up to us; we mediate and own this universal concept. Modern computers are well-built (and will become even better) in order to support fair and effective communication, but they represent only one side of the coin of a modern anthropology. The other side is given by our non-algorithmic capability for personal and social compositions. The potential dimension of information—in close cooperation with the actual dimension—creates and releases the energy of our minds—let us perceive it and use it.

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