Illusions - a model of mind

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Recognizing that all mental processes have to be unfree and passive, we develop a model of behavior and perceptions. We shall see how misleading our intuition is and shall understand how consciousness arises.

I. INTRODUCTION

We are convinced to be like the captain of a ship - equipped with navigation systems like radar, depth sounder on the one hand and rudder, radio equipment, switches and levers for valves and locks on the other hand. Similar, we get on the one hand visual, auditory, haptic and other sensory informations and on the other hand we control and steer our body, walk, grasp, gesticulate and communicate. We are convinced to be free in the sense, to indeed have informations available about our surrounding and our body, but at least expect to be able to control ourselves to a certain level arbitrary. Of course, we know that certain processes are unconscious, like, for instance, the control of our heart. However, we expect to be free at least with respect to conscious behavior.

This picture of a ”captain” on board of our body reveals at a closer look as an illusion; on general grounds it appears to be meaningless to present the sensory signals to any kind of inner ”captain”; our senses have accomplished this task already in transferring the perceptions to our nervous system, that is, have made the information accessible for further processing. Why should these informations be presented once again to an inner ”captain”? In particular, the informations would have to be processed once again within the ”captain” and we were no step further. In fact, the incoming signals, for instance of the visual system, are processed already behind the retina and are directed to different regions in the cortex. Accordingly, there is no localisation in our brain in which the visual signals converge. Obviously, we have to abandon the illusion of a ”captain”. But how does this illusion arise?

A further illusion of the ”captain” is his freedom: we think of a ”captain”, who has information available for instance on monitors, about the current position of the ship and its velocity, but we imagine that the ”captain” is in principle free. We expect the ”captain” to balance different options and to have a certain range of possibilities to decide and act. In this sense we speak of a kind of responsibility of the ”captain”. We will see that also this freedom of the ”captain” is an illusion when we consider the ”captain” in our nervous system.

The absence of our freedom is the crucial point in order to understand our behavior, thinking, our perceptions, and eventually consciousness. The quest for free will is certainly very old [2,3] - and it is still subject to discussions today. In section IV we shall discuss in detail this question about our freedom.

Historically it seemed to be obvious that we are not free, since two break thoughts have been achieved in science: firstly, it became clear that physiological processes are in principle not different from other natural phenomena [4]. Secondly, the principle of cause and effect, the determinism, was recognized as a fundamental and universal principle. These two findings lead to the following question: how could we be free, if our physiological processes have to follow the principle of cause and effect, that is, are deterministic processes? We want to discuss some aspects of this discussion in the section III and we will argue that our freedom is an illusion, in a certain sense independent of the question of determinism.

If we are not free, the question arises, how do we come to our decisions and actions? Since the free ”captain” in us turns out to be an illusion, the question is, how do we steer our ship without any type of ”captain”? Obviously it appears that we in general do not behave like a ghost ship - we act in general purposively. As a consequence of the absence of freedom it is required to replace the ”captain” by a non-free, that is, passive ”mechanism” in order to understand our decisions and actions consistently. This ”mechanism” has to connect the incoming signals from our perceptions, which arrive at our nervous system with the outgoing ones, which represent our decisions and actions. In section III we shall present the ”mechanism” which allows us to replace the ”captain” and shall give a consistent explanation of our behavior and thinking.

In section IV we will focus on our perceptions. If we, for instance, watch the sunset our sensation seems not to be in accordance with electrical action potential in the neurons of our nervous system. With other words, the question arises, how does the electric action-potential activity of neurons correspond to the sensation of a color, say red: the color red - we in general do not behave like a ghost ship - we act in general purposively. As a consequence of the absence of freedom it is required to replace the ”captain” by a non-free, that is, passive ”mechanism” in order to understand our decisions and actions consistently. This ”mechanism” has to connect the incoming signals from our perceptions, which arrive at our nervous system with the outgoing ones, which represent our decisions and actions. In section III we shall present the ”mechanism” which allows us to replace the ”captain” and shall give a consistent explanation of our behavior and thinking.

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this aspect of sensations of perceptions is often denoted as qualia \cite{5–8}.

In section \textsection V we shall discuss eventually how we come to the illusion of a "captain". It is the same question asking for our "consciousness", "self", or "I". Why are we convinced to have a form of "I"? And what is the true meaning of "consciousness"? Based on the preceding discussion about freedom and about decisions and acts we shall arrive at an interesting model of mind. The mathematician G. W. Leibnitz has discussed this question about consciousness already centuries ago \cite{9}. In his monade 17 he is studying the question about consciousness comparing our brain with a mill. We want to reconsider this remarkable thought experiment and shall try to reveal the Nature of consciousness.

It is our aim to develop a consistent model of mind which provides a principal understanding of perceptions, actions and eventually consciousness. We shall reveal the illusions we have in mind and the main focus will be to show how and why these illusions arise. Let us emphasize, that we are looking for a basic model of mind, which will not consider all the interesting details. For example, when we discuss our actions, in a general sense also reflexes belong to actions. But reflexes occur in a very different manner than conscious actions like shooting a ball towards a goal. Reflexes follow inevitably on a certain stimulus; they are "wired" firmly and they follow therefore a different principle than when we shoot a ball. But reflexes do not appear to be in contradiction to our imagination, since we accept them as "mechanical".

We will see that our imagination is very misleading compared to our true nature. We shall see, how in our model of mind these illusionary imaginations arise and shall understand how consciousness appears.

\section{II. UNFREE WILL}

The central point in the development of a model of mind is to realize that the freedom of will is an illusion. The old quest for freedom is still today subject to discussions with very different opinions. This quest for freedom was discussed already by the ancient Greeks Democritus \cite{2} and Aristotle \cite{3}, newer discussion can be found, for instance, by \cite{1, 10, 10}.

In general we are convinced to be masters of our actions and thoughts, to weight and eventually decide freely. A consequence of this imagination of freedom is our understanding of responsibility and guilt, concepts which are deeply rooted in our fundamental law; being guilty of a criminal offense means to commit a violation of criminal law. Finally, to a more or less large extend, our understanding of good and evil, responsibility, guilt and atone are related to religion: if we violate God’s law we sin and are guilty. Despite this big historical heritage with respect to the body-mind problem we shall argue, that under simple assumptions we never can be free. First, we have to define what we mean by free. Let us consider a concrete example: suppose, a waiter offers two kinds of muffins, say a vanilla and a chocolate muffin. We choose one of both, say the chocolate muffin. If this choice were free this means that we could, at the same time, that is, under the exact same conditions, have made an alternative choice. In this example we mean to be free, when we could have chosen the vanilla muffin instead. We preliminary define freedom as the capability to have made an alternative choice, under the same conditions. We will see that this definition not quite gives what we actually expect from freedom; therefore we denote this definition as preliminary.

Let us note that in praxis it is not possible to restore the exact same conditions since this would require to go back in time. Could we repeat the "experiment" of the choice of two types of muffins, we would be able to immediately verify whether we always take the same choice or not. However, we will see that this is not necessary to understand that we are not free.

At a first glance, it appears not questionable that we, following our definition, do have the freedom to choose the alternative vanilla muffin. But looking at it again this appears to be impossible, at least under certain assumptions: we suppose that our nervous system follows the same basic principles as the rest of Nature does. In detail these principles are electromagnetic and biochemical interactions in the neurons and its joints, the synapses.

If we follow \textit{natural} processes, then the choice of a muffin is the result of a cascade of preceding processes. Every process conditions the following. When we have made a choice, while we extend our arm towards the chocolate muffin, then this choice arises from preceding (electromagnetic and biochemical) processes. An alternative choice means that there were alternative preceding processes present, what obviously was not the case.

This argumentation is the determinism, the principle of cause and effect. Our choice appears to be determined, that is, \textit{not} free, because we could not have taken another choice under the same conditions or equivalently, at the same time. Let us mention that this contradicts our imagination of free will. We will come back to this interesting point later.

Firstly, let us consider the assumption that we follow \textit{natural} processes. Nowadays we understand the elementary biochemical and electromagnetic processes in our nervous system. Even that we certainly do not understand our brain as a whole, we do understand its basic elementary units, the neurons, together with its joints, the synapses. Electromagnetic action potentials are transmitted through the neurons and in response, neurotransmitters, that is, signaling molecules, are released and excite the receptors of another neuron. Obviously, the basic interactions, that is, its biochemical processes are principally the same interactions as we observe in Nature elsewhere.

A milestone in this context was the synthetic production of urea. Before, the chemistry of life, the organic chemistry, was strictly separated from the non-organic
chemistry of the remaining, dead, substances. This reflected the idea that chemistry of life is fundamentally different from that of other substances. With the synthetic production of urea in 1828 by Wöhler [1], that is, the production of an organic substance from non-organic substances, this distinction had to be given up. The chemists today denote the molecules based on carbon for historical reasons as organic chemistry, in contrast to non-organic chemistry. This is certainly a strong evidence supporting our assumption. A further evidence that we follow natural processes is that material influences change our thoughts and actions. An example of this is the consumption of alcohol. We recognize the close relation between the material substance alcohol and mind. A further example of this close relation is given by lesion of certain areals of the brain which result in mental changes. But let us note, that the assumption, that our nervous system is based exclusively on natural interactions is plausible but difficult to prove. We will nevertheless make this assumption in our model of mind and shall see that we can in deed understand our thoughts and actions in principle.

Secondly, let us take a closer look at the principle of cause and effect, the determinism. It reflects our daily experience that every effect has a cause: if the stone hits the window with sufficient momentum, the glass will break. When a action potential arrives at a synapse, it reveals a certain amount of neurotransmitters. However, we know that this principle of cause and effect has fundamental limitations: quantum mechanics, discovered by E. Schrödinger [17], tells us that under the exact same conditions we can observe different effects. In Nature there are processes which occur spontaneously. An example of this is the decay of a radioactive element, which decays spontaneously: if we observe two such radioactive atoms they in general decay at different times. Before their decay, both atoms are in every detail identical. The reason is not, that we do not know the exact details of the unstable atoms, but merely it is Nature itself following this rule. For a sufficient large number of radioactive atoms we can only give the half-life time, the time after which about half of the atoms have decayed. However, for a single atom we can not know this time of decay, it appears to be undeterminable. We can compare this with throwing a coin. When we throw a coin sufficiently often, we find that about half of them fall on one specific side. For a single throw we can not determine the outcome with certainty.

If we suppose, that our nervous system underlies the same interactions as everything else we observe in Nature, then we cannot exclude that there are spontaneous processes. With other words, in the cascade of processes it may happen that there appear processes which are not determined. Hence, the processes in the nervous system are natural but not necessarily determined! Following our preliminary definition of freedom, that is, the ability to make an alternative choice under the same conditions, we appear to be free!

However, we have to realize that this kind of freedom does not satisfy our idea of freedom. Obviously, considering a machine, employing a spontaneous mechanism, for instance triggered by radioactive decays of unstable atoms, we would not call free, even that it satisfies our definition. Instead, what we mean by free is to make an alternative choice under the same conditions but not spontaneously or randomly. Therefore, let us define freedom eventually as the ability to take an alternative choice under the same conditions but not spontaneously.

Accordingly, following this revised definition, our decisions and actions are not free, supposed we underly natural processes.

Let us comment on the current discussion about freedom. The physicist Max Planck was also engaged in the quest of freedom [15, 19]. He realizes that the spontaneous, random processes do not make our actions free, but he tries by a kind of "inner" dialog to declare us free. His argument can be sketched following our example of the choice of muffins. Suppose the waiter offers the two types of muffin but we are accompanied by a friend. We discuss with our friend the preferences of the two muffins. Evidently this discussion will influence the process of decision and this may result eventually in an alternative choice. Max Planck states that this process of discussion can take place in our brain in a similar form without our friend present and this makes us free, because, following Planck, this may result in an alternative outcome. But there is a flaw in this argument: of course the friend can affect our decision and we may even come to an alternative choice. However, under the same conditions, taking into account our friend, there appears no alternative process, disregarding for the moment spontaneous processes. When we think of our friend as a kind of a "inner" dialog, we get again to an illusionary kind of "captain". The "inner" dialog in reality is part of the cascade of processes which never can be free. As we have argued, spontaneously processes do not change the argument, because random processes do not count following our definition.

In the literature we can find many variants of this argumentation of Planck; see for instance [14, 15, 20, 22]. Typically there appears a kind of "captain" on board of our body in order to save our freedom. The crucial point is to realize the illusion of this kind of "captain".

We see, that in order to be free, there appears only the possibility to reject the assumption that mind processes are natural. We mentioned some evidences which indicate that the interactions in our nervous system are not anything special, compared to interactions elsewhere, although it appears to be difficult to prove this. The argument to look for something beyond our nervous system is essentially the believe in a "soul" which is believed to have some kind of existence beyond our body. Of course, we can not accept this and will instead try to develop a model of mind under the assumption that mind processes do not go beyond natural processes elsewhere.

In section VI we shall briefly mention some conse-
quences of the absence of freedom. In particular it might appear to be unacceptable to be unfree since this contradicts our imagination. We postpone this discussion after we discuss in chapter V how we arrive at the illusion of consciousness.

Let us close this section with an illustration by Carl Ginet [12] who compared our illusion of freedom with a little child in a ghost train: the child sits in a small vehicle, equipped with a little unconnected, decorative wheel. The child is moving the wheel in the illusion to steer the vehicle which in reality is guided by the rails.

III. THINKING AND ACTING

For the moment we want to extend our findings with respect to the lack of freedom to our thinking. So far we have considered the freedom with respect to decisions, like in the example of the two kinds of muffins. But similar to our decisions, thoughts represent also natural processes, at least relying on our assumption that all processes in our nervous system are of the same nature as processes elsewhere. Without knowledge about the detailed realization of thoughts in our nervous system we therefore assume that they represent neuronal processes. Strictly speaking it is in this context irrelevant that thoughts are neuronal processes, it is only relevant to assume that they are any kind of natural processes. Then, our argumentation with respect to our decisions can directly be applied to our thoughts; thoughts follow from a cascade of processes, disregarding for the moment spontaneous processes. Any process of thinking is preceded by a cascade of other processes, which in turn determine this thinking.

Similar to our definition of freedom of decisions we mean by free thinking the capability to develop an alternative thinking under the same conditions, but not in a spontaneous way. We see that in analogy to decisions there is no freedom in our thoughts.

We see how misleading our illusion of a free "captain" is. The freely acting and thinking "captain" is to abandon. Let us emphasize the passivity of the process of thinking: at a closer look it is not "us", who develop this or that thought, but the thoughts appears in a passive way in our nervous system. An active form of thinking, the creation of thoughts, in contrast, would correspond to a kind of imaginary "captain". How could a thought arise, if not caused by other processes, respectively spontaneously? While I am writing these lines, it is in fact my nervous system, generating this thoughts - it is not my autonomous "I" in a sense of a "captain", who develops this thoughts.

In detail, the process of thinking is certainly very complicated, for instance, it is affected by experiences and memories. These experiences go back probably to our earliest childhood. In addition we are typically confronted with many perceptions, for instance, a sound which distracts us. Nevertheless, these details should not obscure the fact that thinking is a passive, unfree process.

We shall look closer at the Nature of thinking in section V but we already see, that under the plausible and simple assumption, that thinking is represented by natural processes, thinking is as little free as actions and decisions.

If actions, decisions and thoughts are unfree, the question arises, how they are developed instead? The question is, what instead of a "captain" is the principal, unfree "mechanism" between the "input" given by the monitors, the echo sounder and so forth, and the output, that is, the steering of the ship.

Let us first consider as an example a reflex, which is in a general sense a kind of action. For a reflex it is immediate to see the principal unfree "mechanism": when the rubber hammer hits the sensor area at the kneecap then we move our leg. The evolution has equipped us with reflexes in order to react fast and the reflex connects the incoming signals going towards our nervous system with the outgoing signals, the motor function given by the muscle contraction. In the example of a reflex we recognize immediately that the action is not free: the movement follows inevitably on the stimulus. However, this action does not contradict our imagination. We accept the reflex as "mechanical", in accordance with reality.

In general, our actions are not reflexes and we can in general adapt our actions to changing circumstances. In case of the choice of the muffin the "mechanism" appears to be more complicated and this "mechanism" is of course not a reflex. We weigh the advantages and disadvantages, have memories, experiences, visual perceptions and many more aspects which lead to our decision. What is the principle, or the "mechanism", which has to be passive and cannot be free, in order to reach the decision?

We propose that our system of desire and pain signals provides the fundamental principle. The principle, we postulate, is to maximize desire signals and minimize pain signals. We will see that actions can arise based on this principle as required in an unfree manner. Reflexes are excluded from this principle, as discussed already. Considering once again the choice of muffins, the eventual choice corresponds to stronger desire signals: our experiences, memories, the visual impression and so forth guide our nervous system to the choice, because it is accompanied by stronger desire signals than the alternative choice. Maybe, having chosen the chocolate muffin, we are disappointed, because the taste does not meet our expectations. We will memorize this experience and this may lead to an alternative choice in the future. Let us note that we are talking about desire signals and pain signals and not about desire and pain in order to emphasize the "mechanism". The sensation or the experience of desire and pain will be discussed later in section V. To summarize, we postulate that the principal "mechanism" of our nervous system is to reach certain signals and to avoid others.
Some remarks are in order: apparently, the principle of maximizing desire signals and minimizing pain signals is often not immediately obvious. However we want to emphasize that it nevertheless may be the basic principle - excluding reflexes. If we are hungry this is a pain signal which we avoid, when we eat. We take care of our body, avoid injuries and other forms of dangers, following this principle. But if we get up early in the morning and go to work, we can ask, where can we see this principle? But of course, we have made the experience that based on this habit we keep our job. This is in the long term reflected by a regular salary and other benefits, which indirectly correspond to more desire signals. In most cases we do not follow this basic "mechanism" directly, but by a closer look we can nevertheless recognize it as a fundamental principle. Even when we share our meal with someone, this can be seen as a gain of desire signals: we have experienced, for instance, that it is advantageous for us to share since we expect that if we do so others will also share with us.

Of course we see the difference between reflexes and other actions based on the gain of desire signals (together with the avoidance of pain signals). Reflexes are fixed, firmly wired, and do not allow to adapt our behavior to changing circumstances. We move the lower leg constantly, when the hammer triggers the stimulus. But if we have bad experiences with the chocolate muffin, we will probably take an alternative choice. Learning as a change of behavior due to experiences is not possible with reflexes, but certainly following the principle of desire and pain signals. Both principles have in common that we can understand them as unfree "mechanisms", as required.

We can illustrate the principle of maximizing desire signals and minimizing pain signals with a chess program: the chess program calculates different variants of possible moves and values the different positions reached in memory. It then chooses the movement corresponding to the highest value. This is similar to the choice of the muffin where we "value" both possible moves and choose the muffin corresponding to the highest "value", that is, desire signal.

Let us in this context consider a rat experiment performed by James Olds and Peter Milner [24]. In this experiment an electrode was put into a certain area of the brain of a rat. The rat itself can release an electric signal to this electrode by pressing a button. Before, the rat has been trained to use another button which triggers a mechanism such that feed drops into the box of the rat. In the experiment the rat presses the button connected to the electrode continuously. The rat does not consider the other button to the point of exhaustion. We easily understand this based on our principle of desire signals. The electrode hits obviously an area of the nervous system triggering a strong desire signal.

We may argue that this experiment shows the principle in rats and not in humans. But considering persons addicted to drugs, we recognize parallels. These people typically lose their job, neglect social relationships, and often have a tendency to crime - only in order to gain the desire signal, triggered by drugs. The brain has found a fatal way to maximize desire signals. This may explain, by the way, why it is so difficult to get people addicted to drugs to give up this destructive way.

There is no contradiction if we consider someone who hurts himself on purpose. If the pain signal is over compensated by a desire signal this can be understood based on our principle. Many actions may appear to not follow this principle on the first sight, but at a closer inspection we can recognize its underlying mechanism at work. As has been mentioned, reflexes are excluded from this principle.

Moreover, we have seen that a "mechanism" is required in order to explain our actions. Which fundamental principle do we have available except from our system of desire and pain signals? We can also ask what is the meaning of this sophisticated system of pain and desire signals other than providing a mechanism of assessment? Hence, it appears to be exactly the required principle to replace the inner "captain". This principle explains our actions and decisions in a consistent and unfree, that is passive manner. To summarize, we postulate in our model of mind that the principle, maximizing desire signals and minimizing pain signals is the basic principle of actions and decisions apart from reflexes.

IV. PERCEPTION

Suppose we watch the sunset with its deeply red sky. We know that this perception of a color is another illusion: before the light hits our retina, it is an electromagnetic wave in a certain range of wavelength. Of course, nothing of the electromagnetic wave is red. In the retina, the incoming wave excites charges to oscillate in specialized cells. In turn these cells transform the incoming signal into an electric action potential [23]. The complete remaining processing proceeds in neurons in terms of action potentials which seem to have nothing to do with the sensation of the color red. Neither we can understand the sensation relying on an inner "captain" who could get the signals presented on a kind of inner screen. As we have seen in the discussion in section [11] this "captain" is an illusion.

Moreover, the stimulus, after being translated into the "language" of the nervous system, that is, being available in form of action potentials, is already decomposed on its way to the cortex and gets to different separated areas. Of course, the signals do not converge anywhere but are processed further.

What is then our perception of the color red? We realize how difficult this is to answer, if we try to explain the color red to a blind person (someone who was born blind so that he/she has never experienced this sensation). It appears to be impossible. This problematic can be extended to other sensation in an analogous way, and we
see that all our perceptions appear to be illusions.

The guiding principle to reveal the nature of perceptions is the finding that this process is required to be passive and cannot be free. Free or active would mean that the perception is "internally" represented to a kind of "captain" on a kind of screen. Suppose there would be an inner representation, then, this representation would have to be watched by some kind of "inner eye" and we arrive at a senseless loop, also known as infinite regress \([1]\). Since the perception has to be a passive process we have to replace the "captain" by a passive "mechanism".

Of course we know that the meaning of perception is to adapt our behavior to the surrounding. With our findings in the last section we know that perceptions serve to provide informations such that our system of gaining desire signals and avoiding pain signals generates actions and decisions. Hence, we have to consistently explain perceptions satisfying the following requirements:

- Perceptions cannot be any form of "inner" representation.
- Perceptions have to be a passive process.
- Perceptions have to satisfy the functionality to get informations, eventually in order to adapt our behavior.

If we ask ourselves what is red, we would describe this perception in the following or similar way: the color red is the color of an apple, of the sunset, of the ember of fire, our blood and we think of red when we listen to the sound \textit{red} or read the word \textit{red}. Obviously we find that we associate the perception with a bunch of other sensations. We immediately see that these associations indeed satisfy all the mentioned requirements. Therefore we postulate that these associations are the perception which is triggered by the initial stimulus. Building associations to the stimulus given by red light, occurs without any kind of inner representation, is a passive process, and provide us with information about our surrounding.

Let us now consider an auditory perception, when we for example press the key of a piano keyboard. In an analogous way to the visual perception, the sound waves are nothing but fluctuations of pressure in the air which are transformed into action potentials in the hearing. What is then in a passive form the sensation when we listen to the sound of a piano?

We associate the auditory signal with a bunch of sensations, for instance the visual impression of a piano, piano music in our memory, the visual perception of a concert hall and certainly much more. The whole bunch of associations, triggered by the initial stimulus is, as we postulate, the sensation of the piano sound.

A blind person, without memories about visual sensations, has never experienced the color sensation red and is therefore not able to build associations. Of course, we see, that the perceptions are individually different and in particular are influenced by culture. Accordingly, we expect that the Inuits in Greenland have certainly another sensation of the color white than someone how grew up closer to the equator.

A little child, told by his parents, "The apple is red", "This toy is red" learns the perception, triggered by the initial stimulus of light of a certain range of wavelength by the association to the sound of the spoken word "red". The child does accordingly not learn to recognize the color red on a kind of screen, but learns the perception itself, building associations.

We should mention that our system of perceptions is remarkable sophisticated and typically gives very extended associations. But we are interested in the basic principle here without considering all the details.

Eventually, let us consider the sensation of pain, for instance, when we accidentally cut our skin with a knife. In an analogous way the stimulus, triggered by specialized receptor cells in the skin, generates action potentials which are transferred to our nervous system. But there is a principal difference between these signals referring to pain, and the visual perception for instance. The difference is, that our nervous system, stimulated by the cut, tries to avoid this kind of signals. As we have seen in the last section, our actions are driven by the passive principle to avoid pain signals. This distinguishes desire and pain sensations from all other perceptions, which are not a part of our assessment system.

How do we explain the visual perception, when we consider a landscape? We have discussed already, that the landscape does not appear in form of an "inner" representation. When we watch the landscape, we actually recognize different details, a birch there or a cloud above and a lodge over there. We associate different visual stimulus’ entering our eye from different directions with sounds like "birch", or "lodge". All together we associate the perception maybe with "valley", but for this to happen, different details have to appear from different directions. In fact we are not aware of many details, say, a horse, which has been there all the time but only through its whinnies got our attention and now compounds to our sensation. The "picture", that is, the bunch of associations, has changed in this moment, even that the visual stimulus has not. Our visual system is able to distinguish different directions and locations and to recognize patterns. We note that the visual system is very advanced. This is reflected by the fact that the visual system in our cortex occupies a large part. If we consider the photo of a landscape, this photo does not show our "inner" representation, but the photo triggers a sensation which is similar to the landscape itself. We therefore associate the landscape with a "picture" of it.

V. CONSCIOUSNESS

Let us start the discussion of consciousness following a thought experiment by G. W. Leibniz from his monade
Besides, it must be admitted that perception, and anything that depends on it, cannot be explained in terms of mechanistic causation — that is, in terms of shapes and motions.

Let us pretend that there was a machine, which was constructed in such a way as to give rise to thinking, sensing, and having perceptions.

You could imagine it expanded in size (while retaining the same proportions), so that you could go inside it, like going into a mill.

On this assumption, your tour inside it would show you the working parts pushing each other, but never anything which would explain a perception. So perception is to be sought, not in compounds (or machines), but in simple substances.

Furthermore, there is nothing to be found in simple substances, apart from perceptions and their changes. Again, all the internal actions of simple substances can consist in nothing other than perceptions and their changes.

We would like to reconsider Leibniz thought experiment, presented about three centuries ago. Today we know, that at a tour inside the elementary working parts are the neurons, which are pushing each other by means of electrical and biochemical activity. Following Leibniz closely it is evident that we can not find at any special location anything from which we could explain perception, sensing or thinking. This illusionary special location of perception, sensing or thinking we have denoted as a "captain" earlier. The illusion of a "captain" corresponds to our imagination of what we would call consciousness or self or I.

We have seen, that any special location of perception, sensing and thinking leads to contradictions: as Leibniz argues, suppose, we could detect a special location, then, in a further expansion in size we could again go inside and would only find working parts, pushing each other. Indeed, in terms of neurons, we know that the neuronal signals do not converge anywhere. Besides, as we have seen in section [V] any kind of convergence at some location of perception would require some new kind of inner "eye".

Leibniz discusses two solutions, to understand consciousness: firstly, looking for consciousness in the "simple substance" itself, that is, from a modern point of view, in the neurons itselfs. However, we know that the fundamental function of the neurons is to transmit action potentials. This is consistent with our assumption we have made in section [III] that the interactions in the nervous system, based on electromagnetic and biochemical processes, are in principle not different from Nature elsewhere. Hence, we do not agree with the identification of the "simple substance" to be the location of consciousness. But let us mention that nevertheless there are attempts, following Leibniz, to understand consciousness in the neurons itself; see for instance [14, 15, 21, 22, 26].

The second possibility, as Leibniz mentions, is to understand consciousness from the compound. Contrary to Leibniz we want to follow this way, and try to understand consciousness like the phenomena of perceptions, sensing, and thinking from the interplay of the neurons.

Realizing that perception, sensing, and thinking appear from the cascade of neuronal processes in an unfree manner we talk about the emergence of these phenomena. Using the expression emergence we emphasize that perceptions, sensing, and thinking are as required passive processes.

Let us think about this point further. Imagine, under anesthetic, one neuron after the other would be replaced by an exact copy. Of course, in practise this is not possible, but let us consider this as a thought experiment. Since no neuron would be a special location of perception, sensing or thinking, we would in no step replace this special location simply because this location does not exist. The essential point is to see that every neuron is nothing more then a "mechanical" device which is replaced by an equivalent one.

After recovering from anesthesia we would not recognize any change. The neurons would interact in the same manner as before and our perception, sensing, and thinking would appear in the same way. Here we see clearly the illusion of our imagination of we. Following our misleading imagination we would expect that at a certain point our we would have been removed, that is, the illusionary "captain" we expect has left the ship. In reality, there is no "captain" who could leave.

Of course, it makes no difference whether we replace the neurons one by one, or all at once. Evidently, this means that, replaced by a copy, we would develop perception, sensing, and thinking in the same way! Hence, suppose that under anesthetic our body is replaced by a copy, nothing like I or consciousness or self would be lost. That is, our perception, sensing, and thinking is not attached to certain neurons, but appear from their processes. The emergence of our thinking, sensing and actions is clearly seen as originating form the interplay of neurons in this thought experiment.

Let us further imagine that we replace each neuron in turn by an electronic device, which replicates exactly the functionality of the original neuron. As before we would not remove in any step a location of perception, sensing or thinking. In this way we eventually would be replaced by a machine under anesthetic and this machine would develop the same perception, sensing and thinking and we could not feel any difference! In the circuit there would emerge the same processes as before - supposed the electronic devices work like the original neurons. We rec-
ognize that our imagination is contrary to the emergence of perception, sensing and thinking. We are convinced to have some kind of I – a location where perception, sensing, and thinking is formed. Why are we subject to this illusion?

The question is how do we come to this illusion of consciousness or "self" or "I" [27]? In order to understand this, let us see how the I appears in our thoughts. To this end let us consider an example of a perception, for instance the smell of an apple. If we communicate to someone this perception, we say, for instance: "I smell the scent of a fresh apple". We use grammatical first-person in order to communicate our own perception, distinguishing it from a perception of someone else. In contrast, with the communication of "She smells the scent of a fresh apple" we use grammatically third-person in order to denote the sensation of a third person.

But what happens if we do not communicate this statement but only realize the smell? As we have discussed, this thinking must be emergent, that is, occur in a passive manner. We postulate now that thinking is nothing but silent communication. Thinking then represents a communication actually directed to another person. When we smell the scent of a fresh apple, then we associate the sensation with the silent communication "I smell the scent of a fresh apple".

First of all we see, that thinking in this form occurs in a passive way, as required by our findings. We further see, that we have to use grammatical first-person in the thought. We silently communicate our sensation and not the sensation of someone else. The first person "I" appears inevitably in our thought. This "I" or "self" is the same as our consciousness.

In this way the illusion of a location of perception, sensing, and thinking appears automatically - a machine would develop the same illusion of a location of perception, sensing, and thinking. We understand now what would happen in the copy of our nervous system in terms of an equivalent electrical device: in the copy would in a passive manner emerge the same illusion of "I". Our copy would be convinced to be conscious, it would associate the same silent communication using grammatical first-person - compare with the "zombie" in [11]. The machine would be equivalent, and just as little a "zombie" as we - or with equal right we would be as much a "zombie" as the machine.

Now we can easily understand what it means to be aware of something: being aware of the scent of a fresh apple means that there emerge associations to the silent communication. If we are conscious of a sensation we communicate it, but not necessarily verbalize this association.

Let us consider another example, for instance the haptic sensation at our soles of our feet. Before we have read these lines, we were probably not aware of this sensation. This we can now understand easily. Triggered by the words written here, in particular "haptic sensation" and "soles" we associate the perception with the silent communication of the form: "I feel the ground at the soles of my feet". Since it is a silent communication, we use grammatical first-person and it appears the illusion of an I. Before we have read these lines, we were not aware of this sensation, even that the stimulus was constantly there. What was missing was the association with the silent communication.

If we think about something, we imagine to develop these thoughts. We realize that thinking happens to be in reality very different: thinking revealed as a passive process emerges in form of silent communication - if "I" cannot concentrate, this means that the emergent thinking does not follow a certain subject.

Let us emphasize that it appears in principal possible to copy our "I" on a machine. What appears in the machine would not be a copy - it would be ourself. Our perception, sensing, and thinking would appear in the same manner in the copy. As we have argued, our "I" would not be lost in the process of copying. Of course, nowadays computers are not sufficiently sophisticated to simulate the tens of billions of neurons, but there are already attempts - see for instance [28]. Let us summarize what we have found: our "self" or "I" is an illusion in the following sense, it is not the "I" that wakes up in the morning, thinks and feels, but it is passive communications that inevitable emerges involving the grammatical first-person.

VI. CONCLUSIONS

We have seen how misleading our imaginations about our mind are: under the assumption that the processes in our nervous system are basically the same as in Nature elsewhere we find that our freedom is an illusion. We have seen that we have to understand perceptions and likewise actions and thoughts as passive processes. The imagination of a "captain" on board of our body has to be abandoned. Our behavior, we have argued, follows the principle of maximizing desire signals and minimizing pain signals. This "mechanism" we have identified replacing our illusionary "captain". We understand consciousness which appears in a form of silent communication as a passive process as required. Eventually, we arrive at a model of mind which at a glance may appear to reduce us to will-less "machines". But what if we are "machines"?

However, we should realize how powerfull these "machines" are. These machines have composed the St Matthew Passion (see for instance the discussion in [29]) and are investigating the Universe. Artificial machines are far away from these achievements. We are made of a vast amount of neurons, equipped with dedicated sensors and very complex motor functions. Robots appear to be ridiculous compared to us, even that they already play better chess than every human, recognize speech and can build associations artificially.

Let us note that as a consequence of our findings, con-
cepts like responsibility and guilt have no meaning if we are not free. How could we be guilty or be responsible for something if we do not have a choice? We obviously have to think these concepts of guilt and responsibility over. Suppose someone steals a bike, then we actually cannot blame the thief, but still we can blame the action itself.

We have seen that thoughts appear in a passive manner and in reality, we are not able to create thoughts in a free way. This could be misunderstood as a kind of compulsive behavior. But compulsive behavior refers to a mental disorder which is characterized by repetitive actions or thoughts. This is quite different from the required passivity of thoughts and actions. We are not free. How could we be guilty or be responsible for something if we do not have a choice? We obviously have to think these concepts of guilt and responsibility over.

The concept of creativity, in an inspirational sense of thinking, has certainly to be given up. The process of new insights and ideas is merely a synthesis, which originates from the vast amount of impressions and memories. This is the price we have to pay for giving up freedom. The creator in us would be nothing but the illusionary "captain".

Eventually, there arises an interesting feature: replaced by a machine, we could become immortal, supposed it is possible to exactly simulate tens of billions of neurons.

Acknowledgement(s)

Many thanks go to M. Rezgaoui for very fruitful discussions.

[1] Rosenthal, D. *Two Concepts of Consciousness*, Philosophical Studies 49: 329-359, 1986.
[2] Berryman, Sylvia. *Democritus*, The Stanford Encyclopedia of Philosophy (Winter 2016 Edition), Edward N. Zalta (ed.), url: https://plato.stanford.edu/archives/win2016/entries/democritus/.
[3] Tredennick, H. *Metaphysics*, Trans. Hugh Tredennick, 2 vols. Loeb Classical Library 271, 287. Harvard U. Press. ISBN 0-674-99299-7, ISBN 0-674-99317-9, 1933.
[4] Wöhler, F. *Über künstliche Bildung des Harnstoffes*, Annalen der Physik und Chemie. 88 (2), 253, 1828.
[5] Nagel, T. *What Is It Like to Be a Bat?*, The Philosophical Review, 83 (4), 435, 1974.
[6] Jackson, F. *Epiphenomenal Qualia*, Philosophical Quarterly, 32, 127, 1982.
[7] Block, N. *Troubles with functionalism*, Minnesota Studies in The Philosophy of Science 9, 261, 1978.
[8] Dennett, D. C. *Consciousness Little*, Brown and Co, US, 1991.
[9] Gottfried Wilhelm Leibniz in Leibniz The Monadology and Other Philosophical Writings, translated by Robert Latta, Kessinger Publishing Co ISBN 978-0548164266, 2007.
[10] Chalmers, D. *The Conscious Mind: In Search of a Fundamental Theory*, Oxford University Press. ISBN 019511789, 1997.
[11] Cottingham, J., Stoothoff, R., Kenny, A., Murdoch, D. *The Philosophical Writings of Descartes in 3 vols.* Cambridge University Press, 1988.
[12] Ginet, C. *Might We Have No Choice?*, In Keith Lehrer (ed.), Freedom and Determinism. Random House, pp. 87–104, 1966.
[13] Locke, J. *An Essay Concerning Human Understanding (Chapter XXVII)* University of Adelaide, Australia, 2010.
[14] Penrose, R. *The Emperor’s New Mind: Concerning Computers, Minds and The Laws of Physics*, Oxford University Press, 1989.
[15] Penrose, R. *Shadows of the mind - A search of the missing science of consciousness*, Oxford University Press, 1994.
[16] Eccles, J. C., Popper K. R. *The Self and Its Brain*, Berlin, Heidelberg, London, New York: Springer-Verlag, 1977.
[17] Schrödinger, E. *An Undulatory Theory of the Mechanics of Atoms and Molecules*, Phys. Rev. 28 (6), 1049, 1926.
[18] Planck, M. *Kausalgesetz Und Willensfreiheit*, public talk, given at the "Preussischen Akademie der Wissenschaften", 2.17. 1923, url: https://archive.org/details/MaxPlanckKausalgesetzUndW
[19] Planck, M. *Vom Wesen der Willensfreiheit*, talk at the "Deutsche Philosophischen Gesellschaft"", 11.27.1936, VII. issue, Johann Ambrosius Barth Verlag, Leipzig.
[20] Bohm, D. *A new theory of the relationship of mind and matter*, Philosophical Psychology, 3: 2, 271286, 1990.
[21] Hameroff, S. R. *Consciousness, neurobiology and quantum mechanics* in: Jack A. Tuszyński. The Emerging Physics of Consciousness. Springer Science & Business Media ISBN 978-3-540-36723-9, 2006.
[22] Hameroff, S. R. *Quantum Consciousness* 2017, url: http://www.quantumconsciousness.org
[23] Attmanspacher, H. *Quantum Approaches to Consciousness*, The Stanford Encyclopedia of Philosophy (Summer 2011 Edition), Edward N. Zalta (ed.), 2011, url: http://plato.stanford.edu/archives/sum2011/entries/qt
[24] Olds, J., Milner, P. *Positive reinforcement produced by electrical stimulation of septal area and other re-
gions of rat brain, J. Comp. Physiol. Psychol. 47 419-427, 1954.

[25] Pribram, K. H. Brain and Perception: Holonomy and Structure in Figural Processing, Taylor & Francis ISBN 978-0898599954, 1991.

[26] Craddock, T. J., Hameroff, S. R., Ayoub, A. T., Klobukowski, M., Tuszyński, J. A. Anesthetics act in quantum channels in brain microtubules to prevent consciousness, Curr. Top Med. Chem. 15(6), 523, 2015.

[27] Maniatis, M. Notes on Leibniz thought experiment, Neurons and Cognition, arXiv: 1309.0846, 2013, url: https://arxiv.org/abs/1309.0846

[28] Markram, H. The Blue Brain Project, Nature Reviews Neuroscience, 7, 153-160, 2006.

[29] Maniatis, A. Sueño y Arte, Serie Cuadernos de Música de la FADA, San Lorenzo Paraguay, 2013.