



Brain Equation and Personogenesis

Otto E Rossler^{1*}, Lisa-Ruth Vial¹, Frank Kuske¹, August Nitschke², Takashi Ikegami³ and Andrei Ujica⁴

¹Department of Science, University of Tübingen, Germany

²Department of Humanities, University of Tübingen, Germany

³Department of Multi-Disciplinary Science, University of Tokyo, Japan

⁴University of Design HfG, Karlsruhe, Germany

Abstract

The deductive mathematical theory of the brain equation of 1974 is put into an applied perspective. The equation is intuitively shown to be able to explain also the central ontogenetic phenomenon of “personogenesis”. Specifically, an interactional “dynamical function change” in the sense of Robert Rosen can occur between two coupled brain equations. This finding puts “persons” in the sense of Immanuel Kant into a class of dynamical systems of its own. If two brain equations are coupled in a certain symmetric fashion, then either partner system can suddenly see the other as actively pursuing its, the first’s, own goals. This mechanism allows for a causal understanding of the sudden shedding of “physiological autism” in early childhood. The human condition and its place in the cosmos can thereby be understood at long last. The original motivation for the theory was the presentation of a causal therapy of early childhood autism in 1975 in San Diego. As a consequence, “smile-blindness” – a mere sensory defect regarding the usual bonding effect of the smile – suffices for a functional explanation of this debilitating medical syndrome. Autism then is non-pathological. The proposed “smile-laughter theory” by implication suffices for a causal therapy. The therapy is so simple that it can actually be extended to other intelligences capable of bonding – even if they reside in radically different biological bodies. This daring proposal will, once it is empirically confirmed, put an end to the five decades long reluctance of the medical profession to apply the causal therapy of autism to human children. The offered scientific “child theory” started out with the historical Jesus’ first full understanding the heart of a child and was eventually continued by Pestalozzi, Fröbel, Martin Buber, René Spitz and, most recently, Klaus Giel. The workings of the mind of a young child are still totally under-investigated. The predicted sudden occurrence, in the playroom, of the “personogenetic bifurcation” has apparently never been documented on the web amongst the plethora of early-childhood video clips. But because there is no single more deeply heart-moving (“holy”) event on the planet if the offered child theory indeed holds water, it is not surprising that this ontogenetic transition was apparently never documented on video given the natural tactfulness of the human heart. The recently proposed “elephant model” will, if successful, enable human society to understand and respect its own essence for the first time. The lack of this very knowledge in society explains the empirical acceptance, up to this day, of the satanic curse of warfare (“collective autism”), as first adopted in the wake of the invention of agriculture about 11 millennia ago.

Humankind’s lack of knowledge about what constitutes its heart can be healed. The current risk of planetary self-annihilation (naively adopted at CERN) cannot be continued any more once the superior mind of the “first persons” – the toddlers – is appreciated by the scientific community.

Keywords: Brain equation; Personogenesis; Causal therapy of autism; CERN; Szilamandee

Introduction

The brain equation [1,2] assigns to every direction in the surrounding space of a mobile organism a directional weight that is either positive (attractive) or negative (repulsive). This weight depends on the positions of the momentarily closest sources relevant to survival. The sources belong to but a few types (say 5). Picture in your mind filling stations of 5 colors, scattered in space. The momentarily valid filling state of each colored on-board storage tank is as important as is the momentary distance to the closest equal-color filling station. The resulting momentary “directional weights” jointly define an “artificial brain” that controls motion in space. Specifically, the closest source of each type assigns an additive – either attractive or repulsive – force to every direction in space. The source-type

OPEN ACCESS

*Correspondence:

Otto E Rossler, Department of Science,
University of Tübingen, Geschwister-
Scholl-Platz, Tübingen, Germany,
E-mail: oeross00@yahoo.com

Received Date: 02 Dec 2018

Accepted Date: 05 Feb 2019

Published Date: 08 Feb 2019

Citation:

Rossler OE, Vial L-R, Kuske F, Nitschke
A, Ikegami T, Ujica A. Brain Equation
and Personogenesis. *Clin Pediatr.*
2019; 2: 1011.

Copyright © 2019 Otto E Rossler. This
is an open access article distributed
under the Creative Commons Attribution
License, which permits unrestricted
use, distribution, and reproduction in
any medium, provided the original work
is properly cited.

specific attractive forces have a circle-of-Thales shape [1]. And for a repulsive source, the force has the shape of an inverted simple leaf [1]. The underlying class of problems was first spotted by Eric L. Charnov in 1973 [3] in his thesis which went unpublished for several years, and simultaneously in a more formal way in a paper presented at the 1973 Trieste meeting [1]. Two decades later, Friedrich Dörner [4] would again independently arrive at the same idea in an analog-computer-type cybernetic scenario.

In the present simple class of formal models, every direction in space exerts a positive, or (for survival-threatening sources) negative, force that depends on the momentary position of the point-shaped abstract moving organism in 2-D space. The mutually additive forces depend on the momentary distance to the closest source of the pertinent source type, and on the momentary importance for survival of this source type, that is, on the time passed since the last encounter with a source of this type. While Konrad Lorenz's [5] "psycho-hydraulic model of motivation" can be helpful in acquiring an intuitive understanding, the present first-principles deductive theory is valid independently of any biological observations. That is, it belongs into the context of "deductive biology" [6].

As we saw, each positive direction-specific weight contributes an attractive force. All directions adjacent to the direction of shortest distance to that source obtain smaller attractive forces – in the shape of a circle of Thales. The latter implies that only the perpendicular and all backwards-pointing directions have no attractive effect.

And – if life-threatening (negative) sources are included as well – the direction pointing directly away from the closest source of that type has the strongest negative pull (that is, push). In this case, even sources that point laterally do still have a certain negative weight in a leaf-shaped overall manner [1].

The point is that the directional weights are not peaked, as a delta function is over the circle of all directions, but rather do vary continuously with angle in a lawful manner. All of this is described in detail in reference [1]. The local sum over all n momentarily valid forces, positive and negative, determines the momentarily valid directional net pull exerted on our moving abstract organism in 2-space. A three-dimensional generalization is straight forward but adds nothing new in principle.

The described recipe turns our moving abstract organism into a sophisticated "autonomous optimizer". The negative sources have only a space-dependent but no time-dependent (repulsive) effect, while the pull of positive sources is time-dependent. Note also that the pull is zero immediately after a "feeding encounter" with a source of the pertinent type. The pull then becomes arbitrarily large eventually in case a source of positive type (say, water) has not been encountered in due time so that the corresponding "on-board tank" is almost depleted. If the depletion becomes total for a single source type, this fact implies the end of the game for the autonomous optimizer in question. Both survival-relevant and procreation-relevant positive sources do coexist. Procreatively immature individuals ("children") are controlled solely by the former type.

Every positive (attractive) weight depends on time in a nonlinear fashion. The shorter the remaining time span, left until the on-board store for the source type in question is depleted, the stronger is the weight pulling in the direction of the closest source of this type. The pull eventually approaches infinity, as mentioned. See Equation 18 in reference [1] and Equation 1 in reference [2] for an explicit expression

for the here verbally if exhaustibly described brain equation.

To include here the quite cumbersome explicit version of the equation would not add any new information for the reader. Conversely, there can be no doubt that without the detailed verbal description just attempted, the "brain equation" itself – derived in much detail in ref. [1] and repeated in compact form in ref. [2] – is virtually impossible to understand and improve upon. In the following, some further details and implications of the brain equation are to be offered.

Some Explanatory Remarks

Greater closeness in space increases the attractive weight of a positive closest source of a given type as mentioned. The same holds true for the repulsive weight exerted by a negatively survival-relevant source. The direction dependences are different in the two cases as mentioned. The "brain equation" itself [1,2] has never been implemented so far in a technological device. Wilfried Musterle [7] came close in the 1980's in unpublished work. So did a student in Tokyo whose work tragically did not get finished. His name deserves to be remembered by the community. Theoretical biologist Michael Conrad called the underlying decision-type travelling salesman problem the Rossler task [8].

Werner Reichardt confided to the first author in 1978 that he considered it "unethical" to make biocybernetic insights into brains (in his case the fly's brain) "too transparent" so that "scientists with an anti-ethical motivation" can put them to direct use. A first simulation of two coupled simplified brain equations was presented at the New York Academy of Sciences meeting in 1986 [9]. (A nostalgic remark: the conference invitation came with a ticket for a supersonic Concorde flight attached to it.)

A merger with contemporaneous robotic approaches is bound to occur in the near future, Seaman and Rossler [10]. For historical reasons not easy to unravel, both the highly successful modern science of "bioinformatics" and the related field of "robotics" have both so far remained unaware of the deductive-biological approach. Compare reference [11] for a review written three decades later which at the time got crowned by Daniel Dubois with the "Chaos Award" sculpture (if a second nostalgic remark is allowed).

Theoretical Features

The "brain equation" as sketched above does by definition only lead to a "locally optimal" solution of the underlying "travelling salesman with alarm-clocks problem" (as it can be called). The latter constitutes a well-posed mathematical task within a field originally called "operations research". There exists a famous learned book in that field titled "Computers and Intractability: A Guide to the Theory of NP-Completeness" by Garey and Johnson [12]. It for some reason leaves the second –the biological – significance of the underlying deductive mathematical theory unmentioned. Admittedly, the assumption of several "town types" (or "gas station types" or "colors") made in our present travelling problem adds a special flair to the biological-ecological special case of NP-completeness. However, this biological motivation does not detract from the mathematical complexity of the underlying problem as an (in the limit) "Gödel-type problem". As a mathematical curiosity, it is perhaps worth mentioning in this context that there exists a pertinent paper which consists of nothing else but a single line (the title) in the form of a theorem [13].

The brain equation still represents “virgin territory” to date. At this point, a disclaimer is on line: The brain equation itself as described is not yet sufficient for an optimal solution to the “travelling salesman with alarm-clocks problem” to be determined. It only enables a “locally optimal solution” to be sought. Fortunately, however, a better “supra-local” (and in the limit arbitrarily optimal) solution can easily be found on the basis of the brain equation as described – so that the latter indeed deserves the “Gödelianrank” implicitly attributed to it. All it takes for this to be the case is to equip the described “locally optimal” brain equation with a “closed-eyes” (and switched-off-motors) added mode of operation. This added capacity of a merely “simulated motion” controlled by the brain equation (with the motors intermittently switched-off so that many courses to be taken can be tried out in a “virtual optimization” mode), before the motors are switched on again to implement the best solution just found, suffices to include “supra-local optimization”. The added simple simulation machinery makes the brain equation arbitrarily powerful in the Gödelian direction. The added new mode of operation with closed eyes can be called “thinking”.

The single optimal solution that exists mathematically speaking, as long as the number of “towns” to take into regard in our travelling salesman problem remains finite, can be attained in principle if the allowed error rate approaches zero. However, this mathematical insight remains merely theoretical for two reasons: First, the single absolutely optimal solution makes no sense to be sought for in biology because biological organisms always have a finite replacement rate (so that a certain error level is allowed). Second, the optimal solution – which exists when the maximum allowed distance between sources of the same type approaches the maximal “filled-tank travelling radius” for that type – is of little theoretical interest because no biologically realistic environment rules out that sources of one or several types can be mobile as we saw.

The brain equation, if implemented in a technological or biological device, approaches the famous “Gödel solution” of pure mathematics in the limit of the number of towns going to infinity. This is the subject matter of “NP completeness”: the solution in question is the same solution which is known to be undecidable. This limit-type connection between the present, mere “informatics-type problem” on the one hand and the famous intractable Gödel problem of pure mathematics on the other appears to be unfamiliar. In other words: the “limit character” of the Gödel solution arising in the present context does add to the understanding of Gödel’s problem in general. It thereby detracts a bit from the deep mystery of the pure-mathematics Gödel problem itself. This fact – that the brain equation enables Gödel’s problem to be viewed as a limit – can be hoped to help retrieve a bit of the original so highly intuitive character of Gödel’s famous mathematical idea. Conversely, the fact that the “personogenetic bifurcation” which is implicit (as we shall see below) actually belongs into the context of “Gödel type problems” attests to the deep mathematical nature of personhood.

Four Further Features of the Brain Equation

So far, only sources distributed at random in a 2-D space were assumed in direct connection with the original travelling salesman problem. Moving sources are hereby automatically covered, too, if the universal simulator (needed for the mentioned “closed-eyes-and-shut-off-motors” mode) is made powerful enough. The design of this built-in “Virtual Reality” machine is mathematically trivial as mentioned no matter how powerful its performance becomes. This

component can be called a “Helmholtz Machine” since Helmholtz first conceived of it after having passed by the “Loreley” rock on one bank of the river Rhine in a boat, and then having had a realistic dream about his passing that rock in a different way along a different realistic path that had not occurred in reality. Hence memory alone cannot possibly have accounted for the realistic experience Helmholtz had in the dream so that a new mathematics (later called “group-theory”) needed to have been employed by his brain.

But pure mathematics and its trivial special case of flight simulation is not the only profiteer from the brain equation. A specific advanced performance of the added universal simulator is called “mirror competence.” This functional capacity comes free of charge when the added “flight simulator” is only made powerful enough. Mathematically speaking, mirror competence is a trivial side implication of the “group theory” which owes its existence to Helmholtz and his dream.

Secondly, the so far assumed “absolute randomness” of the distribution of sources in the surrounding space can be relaxed. While in the ideal case of total randomness, the addition of long-term memory makes little sense since nothing ever recurs close to before in a fully randomized environment, this restriction does not hold true in more realistic environments that contain a good deal of redundancy in space and time. Here, an added ability to “reload” previous situations and to “re-play” whole scene sequences as parts of a previous trajectory, in an added long-term memory store (plus an added object memory), enables a major functional improvement.

Thirdly, applications of the brain equation in autonomously moving systems will profit from the addition of color-specific sensors, and of detectors for contours and shapes, and of sensors for sounds and smells and maybe magnetism, etc. All these can be combined with non-panoramic, movable camera eyes.

Fourthly, the brains of very small fish – like *Pandaka pygmaea* [14] or *Danio rerio* [15] – are bound to become understood much better soon in a currently going-on global effort to achieve a deeper understanding of the vertebrate brain. Werner Reichardt consciously devoted his life to the house fly’s brain at age 27, as he told the first author 5 decades ago. It appears that so far, no one has in a similar loving fashion devoted her or his life to the almost equally small brain of a pygmy fish, although the latter is infinitely closer to the human brain, not only in terms of hardware but also because an insect brain implements only a non-centralized, mathematically simpler analog [1].

Finally in this context, a second biological class of brains exists besides that of vertebrates that is equally deserving of a better understanding in terms of the brain equation: that of mollusks. This genus includes mirror-competent species (see [16] for a YouTube video which demonstrates this fact although the authors do not say so explicitly since no mirrors were involved). One witnesses here the same spontaneous time-delayed copying of sophisticated movements that were previously impossible to invent by an individual, in an octopus to solve a given spatial problem, as one is used to from certain highly evolved vertebrates. This observation no doubt amounts to a demonstration of mirror competence in the species in question.

A third biological candidate class is that of the mantis-related, highly developed organisms with their fantastic eyes and motor features, most of them still uninvestigated. A rare mirror-competent species may exist there, too. It would be maximally worth looking for.

In either of the two non-vertebrate classes of animals, it would also be worthwhile to search for a highly social species exhibiting pair bonding – notwithstanding the fact that this behavior is so far only known from vertebrates endowed with long-term brood care.

Mirror competence, again

As we saw, mirror competence arises automatically in the brain equation if the added universal simulator (VR-machine) is only made powerful enough. A fleeting “simulational identification” with the mirror image then is an automatic functional consequence. Highly brained birds digging out food they had hidden while a conspecific was watching form a case in point. Nevertheless it would be misleading to attribute to these species a “theory of mind” (although this often is claimed implicitly). For projecting oneself into a conspecific’s position and acts is not the same thing as conversely seeing with the latter’s eyes, that is, sharing the other’s momentary desires.

Historically speaking, the functional capacity of mirror competence was first observed in biology by Köhler W [17] in chimpanzees in 1916 on his station in Tenerife. This functional competence has since become well known in biology, both from highly evolved mammals like apes, dolphins and elephants and from birds including magpies [18] and, no doubt, keas and new-Caledonian crows. And possibly so also from some mollusks as mentioned. Mirror competence can be achieved easily – if an artificial intelligence based on the brain-equation is equipped with a sufficiently powerful universal simulator (flight simulator) and long-term memory as mentioned [19].

It goes almost without saying that artificial brains with mirror competence – that is, the most sophisticated version of the brain equation plus simulator – are easy to endow with social propensities. To this end, the most efficient and simplest means is to let the joy (the positive sum functional) of the one autonomous optimizer with cognition be reflected in a visible or audible behavioral signal, and to let that signal act as a rewarding environmental input for the other side (so that the sum potential over there is increased, too, and possibly even more so). This type of “social wiring” between two mirror-competent brain equation carriers is of special theoretical interest in our context because it implies a further functional capacity: “person competence”.

Person competence

This functional competence is easy to implement hardware-wise. However, it is not being selected-for in biological evolution, notwithstanding the fact that one would naively expect this to be so. Actually the opposite holds true: Person competence can arise only “by accident” in biological evolution (as it did several times) as a mere by-product of other, positively selected-for, features.

It probably comes as a surprise to the reader that the “person status” of human individuals is not something that is positively selected by biological evolution. The opposite rather holds true. For the reign of the automatic process of biological evolution as discovered by Darwin and by Wallace and later by Teilhard de Chardin, is interfered with once functional persons have arisen by accident. This is because persons necessarily act in ways that violate the reign of natural selection. The blind innocence of biological evolution, which only asymptotically (that is, not in finite universe time) approaches the famous “Point Omega” of Teilhard de Chardin’s [20], is automatically violated by many a personal (for example, benevolent) decision-making on the part of a biological creature.

The “hominization” of the individual [20] – if viewed from the vantage point of Darwinian selection (or of fascist etc. ideologies claiming to copy it) – is a type of individual functioning and personal responsibility-taking with a heart which automatically sets biological evolution out of function. This is because “physiological autism” is all that is being selected-for by biological evolution. The thereby implied “infinite innocence of animals” – their total inability to look into another individual no matter what is being hoped-for or suffered from over there – was already famously reproduced functionally by “behaviorist” Burrhus Frederic Skinner when he treated his son in a “Skinner-box” type operant-conditioning fashion. The soulless behavior shown by him out of ideological reasons is all that consciousness-free biological evolution can select for: “behavior”. In other words: “Nature is pure behaviorism”. And so unfortunately are, by the way, robotics and the science of informatics along with that of AI: up until now. Amazingly, the humanities did not yet invade those scientific fields even by an inch so far (as will become clearer in the following).

The “competence for personogenesis” – even though automatically implicit in the brain equation endowed with cognition – is not something that is selected for by biological evolution. It can only become functional in biological evolution by accident – under a very specific type of interactional coupling on the level of the individuals. The particular functional coupling which characterizes persons can arise in nature only by an “evolutionary accident” and, on top of it, by an epigenetic accident that it enables to occur. As such, it is not only bound to be maximally rare in evolution but also bound to be eliminated again by Darwinian evolution – unless conscious knowledge of this fact can prevent it. The famous controversy between Darwin and the more humanistic minded Wallace thus had a deeper root.

More specifically, the preconditions necessary for “personogenesis” to occur on the epigenetic level can arise only by accident – through “evolutionary ritualization” in the sense of Julian Huxley [21] to be specific. Huxley ritualization explains how a specific hard-wired social signal can have arisen in a given species. A familiar example is the evolutionary adoption of “mounting” as an expression of pair bonding, a phenomenon familiar from several social species including baboons, for example. Some extremely social animals even evolved a “pseudo-penis” in the females to in this way render the newly evolved feature of pair-bonding and its freshly adopted expression maximally effective symmetrically. Pair bonding comes and goes on the evolutionary time scale in the history of species over time scales of the order of a million years. Huxley saw that when it is newly adopted, a pre-existing behavioral trait is haphazardly “ritualized” into the new function of acting as a bonding signal. Mounting often got “ritualized” in this fashion into becoming a hardwired expression of bonding, too. However, any other characteristic behavioral trait can be and often has been usurped so as to by chance become the newly necessary bonding signal. This shows how strong a functional trait bonding represents when it is newly adopted in evolution. It is being adopted and abandoned again over evolutionary time spans in the vagaries of Darwinian evolution [21]. Bonobos, for example, use intercourse itself for the new social purpose, with a totally different motivation that is often misunderstood by human onlookers. To call these animals “oversexed” would reflect a deep misunderstanding, so notwithstanding the fact that the new “bonding orgasm” sometimes happens to be procreative as well as a side effect.

When in the evolution of the human species, pair-bonding likewise arose anew more than a million years ago, untypically a signal got ritualized into an expression of bonding that stems from a very different social context – that of brood rearing. The facial expression of the satiated suckling infant got accidentally ritualized (in the Huxley sense) to become the expression of bonding in the ancestry of at first several human species. The facial expression of the happy infant became the bonding smile. Even the human cheekbone with its functionally useless broad anatomical width still reflects the strong selection pressure for the newly adopted bonding signal. This particular example of “evolutionary ritualization” à la Huxley is still so recent in the history of the human species that it still remains non-functional in a non-negligible fraction of individuals born. The latter then still go unrewarded by the evolutionarily speaking “new” optical bonding signal, the smile, when shown by the social partner. As a consequence of this specific blindness (“smile-blindness”), these individuals unlike the rest do not spontaneously shed the “physiological autism” that characterizes the whole rest of the biological kingdom as we saw.

Two brain equations, coupled

A functional coupling between two autonomous optimizers that are both governed by the brain equation plus universal simulator and long-term memory can, of course, occur in many different ways. “Competition” is one familiar type. But also more direct types of coupling are possible. Amongst these, “unilateral caring” (brood-care) plays an important role in the, so-called “social animals”. In those species, a certain kind of behavior shown by the one animal acts as an input to the other which then elicits a built-in (“innate”) social behavior like feeding or cleansing the young. Such a coupling is especially effective when it is not just an accompanying signal (like a pattern visible on the back of the wide-open beak of a young bird) that triggers a specific action pattern (feeding), but when it is the sum functional itself (that is, the momentary level of happiness) that if displayed acts as a rewarding (sum-functional increasing) input for the other side. This type of “caring” is indeed widespread in biology. All “higher” social animals are characterized by a functional coupling of this type.

Artificial autonomous optimizers based on the brain equation can readily reproduce this biological phenomenon of “brood caring”. The consequence then is a functional reproduction of the “social behaviors” so abundantly observed between parents and offspring in the brood-rearing higher animals – like mammals and birds and crocodiles (and possibly also some octopus species yet to be discovered).

This particular “social coupling” consists in one partner being rewarded by the displayed reward level (the sum functional) momentarily valid in the other. This type of coupling is most sympathetic to watch in nature for a human being. When it is implemented in an artificial system (or rather two of them, one active, one passive), nothing surprising happens for a human onlooker for this is how all higher animals work, as we saw. In this vein, risky “sacrifices” (blind sacrifices) do occur between mother and offspring in many social animals. Chimpanzees and elephants are even known to “mourn”. And the reader no doubt knows how rewarding the friendship and readiness for self-sacrifice of a faithful dog can be.

But as moving as it is to observe in an animal, this “caring-type” bonding, the latter does not amount to a radical change in the functioning of the natural system observed – nor in that of an artificial

system that likewise implements the brain equation with cognition and memory under unilateral caring-type coupling. We then only have an “artificial social animal” in front of us. The underlying principle is just that the displayed momentary state of well-being (level of the sum functional) valid in the brain equation of the one autonomous optimizer is being displayed and acts as a rewarding (sum functional increasing) input to a specific sub-functional in the brain equation of another autonomous optimizer. This “brood-caring behavior” is easy to reproduce functionally between two artificial systems based on the brain equation. Whether the artificial dogs currently offered to the lonely elderly in Japan are already equipped with this trait is hard to tell.

However, this is not yet the end of the story regarding “social couplings” in the present formal context. Apart from this asymmetric type of coupling (call it “unilateral caring”) it is, of course, also possible to implement a symmetric bilateral social coupling. This coupling is implemented in nature only in the “play mode” of young social animals like two wolves or dogs where it is fascinating to watch when switched on. Such a symmetric type of social coupling can be called “cross caring”. The canids and the hominids appear to be the only species known to be coupled in this way. One relative of the wolf, the African wild dog (*Lycaonpictus*), is possibly the most social mammal known (besides the eusocial naked mole, of course). However, nothing surprising is being triggered to occur under the cross-caring type of coupling in these canids due to the absence of mirror competence.

A “function change” when cross-caring is combined with mirror competence

Unilateral caring is but one type of sophisticated social coupling that can be implemented between two brain equations with cognition and mirror competence. The bilaterally symmetric – “cross-caring” – type is of course equally easy to “wire in” technically speaking. In this case, the displayed momentary sum functional (“joy”) of the one side acts as a rewarding input to a specific sub-functional – call it the “caring-type” sub-functional – on the other side: and vice versa.

This type of cross-coupling is maximally nontrivial. It causes a new interactional “dynamical instability” to exist between two autonomous optimizers with cognition and mirror competence. When each is rewardable by the displayed joy of the other, the two predictably embark on the one effectively trying to make the other happy and vice versa. And if the two brain-equation carriers with cognition are in addition mirror-competent each owing to a high enough performance level of the universal simulators involved, a dynamical instability predictably arises: a “function change” in the sense of Robert Rosen [22]. If the displayed joy of either partner acts as a strong enough reward on the other side, the implied instability is of a radically new type:

The two autonomous optimizers with cognition then are suddenly catapulted out of their former deterministic mode of functioning. The hereby implied logical contradiction-in-terms is interesting to ponder even from a purely mathematical point of view.

Personogenesis

The new function change just predicted as an implication of the assumed cross-caring type of coupling is unique in dynamical systems theory. Something radically new arises that puts an end to the normal functioning of the two deterministic autonomous optimizers with cognition and long-term memory. The effect even looks like

a “functional disease” if you look at it with the detached eye of a biologist: The two deterministic partner systems suddenly cease to act deterministically even though this is not possible by definition at first sight at least. Are they crazy?

The two autonomous optimizers do remain, of course, the deterministic machines they are from the outset. The new erratic behavior which arises could be called “schizophrenic” (controlled by two minds) in contrast to the former “monophrenic” mode of functioning. The previous biologically speaking “reasonable” deterministic behavior of each partner system is now suddenly gone. Instead, an unpredictable “free will” has taken hold in a seeming violation of determinism and logic.

Specifically, either side suddenly embarks on trying to make the other side happy. What happens is in principle no different from ordinary brood-caring except that it is symmetric. This symmetry can occur also between a dog and her puppy since both likewise are rewarded by the other’s tail wagging. However, this “same symmetry” entails a radically new consequence now if mirror competence is added on either side. Then a new type of qualitative functioning arises in this particular “function change” that arises (to use the terminology of Bob Rosen [22]). However, what occurs is not just a different mode of functioning in a class of ordinary dynamical alternatives as this is the case in all other known examples of a dynamical function change. It rather is a radically new type of functioning that suddenly takes hold in both out of the blue sky.

Some Details

The new functional state into which the two socially bonding autonomous optimizers with cognition, memory and mirror competence are predictably catapulted, under the assumed condition of a high symmetric rewardability by a positive sum functional (joy) on the other side, is not just a new type of deterministic functioning as one is used to getting from animals and machines. Rather, it consists in the sudden shedding of deterministic functioning itself: A radically new mode of functioning is predictably adopted spontaneously by either partner system: “acting as a person”.

This prediction sounds maximally implausible. Nothing like this is familiar from the dynamical literature. The assumed two deterministic autonomous optimizers with cognition, mirror competence, memory, bonding and rewardability by the joy of the other side suddenly get catapulted into an entirely new mode of dynamical functioning. They embark on doing something radically new. They do not just start caring for each other by “taking turns,” as one might expect at first (so that sometimes the one side and sometimes the other does the other a favor dependent on the momentary initial conditions). Rather, something radically new arises sowing to the mirror competence present on both sides: The two start checking on the other’s internal state. Specifically, they both form an anticipation (“suspicion”) regarding the other’s behavior: that the received reward initiated by the other side were “deliberate” – that is, that it was intended to have this good effect.

Of course, the other’s behavior represents a deliberate act like any other action shown by autonomous optimizer with cognition, for the two are hard-wired with fixed goals. Brood-caring was deliberate in this sense. However, its aim was not to make the young partner happy even though this is what was monitored by the feeding adult if unknowingly. Note that the brood-caring situation, despite its close similarity to the present situation, represents only the fact that

one partner attempts to get rewarded by the other’s displayed joyful response to its own performance, which is well known from the brood-caring situation in animals as we saw.

Compare in this context for example the beautiful account given by the Crislers in their filmed report. They kept individuals of two generations of wolves in their igloo in the Arctic while filming the Walt-Disney movie “Arctic Wild” [23]. One night, the human caretakers had too much pity with the almost starving young wolves whilst the adults were out in the cold dark hunting – so the young were already satiated when the adults came home at long last with the sparse food they had managed to carry home in their stomach (used as a carrying bag) during their extended hunting trip. So the young showed not the slightest joy or interest – a fact which let the adults virtually break down. For the anticipated display of the excited joy of the young was what had motivated them during the whole harrowing hunt.

But here in our present case now, with bilateral mirror-competence added to the bilateral rewardability by the partner’s joy, a functional “twist” or “knot” (or something even more alien) suddenly applies: Both sides are doing the same thing in a spatially and temporally mirrored fashion – much as expected with the trivial “turns-taking hypothesis”. However, this is not all. The symmetric coupling in the presence of bilateral mirror competence necessarily entails a further instability with radically new observable consequences.

While what occurs still looks like turns-taking at first sight, it actually is something radically different. A tentative anticipation arises on either side as a “suspicion” waiting to be confirmed: That the so rewarding behavior shown by the other side was intentional as such – deliberate. Which of course it is, like any ordinary unilateral caring act. However, it now suddenly is as if the rewarding good effect experienced over here had been anticipated and was intended as such to occur here, by the other side. So as if the very effect elicited here had been anticipated and wanted over there.

The present theory is very alien. It is still so conceptually new (despite its being 50 years old [24]) that doing justice to it conceptually is close to impossible. One could, for example, say that the original “behavioristic attitude” shown by the two autonomous optimizers equipped with a powerful simulator has, under the cross-caring type coupling, suddenly given way to the adoption of a “humanistic attitude”: That the “suspicion of benevolence being present over there” – of a wish that the good effect arriving over here should take place – was suddenly born on either side in a mutually confirmatory fashion. And that this very foreign intention is then registered on either side, and so on in a positive feedback. Such that, each side excitedly “confirms” to the other the suspicion of a deliberate intention that this message should arrive being present behind this side’s actions.

The newly entertained suspicion of benevolence (of the wish to make happy) being present on the other side, however, is nothing else than a sudden recognition of the other side as a person. Namely, as an experiencing foreign consciousness and will and soul that is benevolent as such – wanting to do good over here. This sudden suspicion occurs symmetrically and is interactively self-amplifying and mutually confirmatory in a positive cross feedback that engulfs all possible mutual actions.

In this way, something radically foreign arises “out of nothing” as a mathematical instability in a run-away fashion – in this particular type of “function change”: Suddenly behaving like (and therefore

being) a person.

Personhood

The Latin word “persona” meant “mask” in ancient Rome. Literally speaking, the verb “per-sonare” means “to sound through”. In the traditional ancient theater, the wearing of a mask, held with the aid of a visible supporting stick in front of one’s face so as to “sound through” through it (“per” means through and “sonare” means to sounding), eventually led to the modern term “person”. Historically speaking, this term was apparently first used in the modern sense by philosopher Immanuel Kant [25]. In ancient Rome, it referred only to the “personae” seen in action on stage in a theater piece, but not to the actors themselves.

In our present formal case, the two mirror-competent brain-equation carriers with cognition and memory and mirror competence suddenly become, if coupled in a cross-caring fashion, their own masters: By each side striving to make the other side get a boost in its own sum functional (become happy) and appreciate the attempt of being tried to be made happy by the first’s deliberate actions.

This sketched transition amounts to the sudden shedding of the intrinsic (“physiological”) autism of the two deterministic autonomous optimizers with cognition employed. In this way, the effect-oriented “behaviorism” that characterizes all animals in nature (and all artificial autonomous optimizers with cognition constructed up until now) gets spontaneously shed in a burst. This radical transition – which is known to every mother of a toddler but is never spoken about by her – predictably, occurs now also between two artificial brains endowed with cognition and long-term memory – if both are rewarded by the internally modeled happiness of the other side.

The upshot

The story just sketched is both trivial and preposterous and, most of all, heart-moving. The involved two autonomous optimizers with cognition and long-term memory, if each rewardable by the displayed sum functional (joy) of the other side, are, despite just having become persons, of course still bound to remain “very stupid” at first. Just as young children automatically are at first, owing to their almost total lack of experience. But the two partner systems do now suddenly function in an “other-centered mode”. This radically altered way of functioning overthrows their previous deterministic (autistic) mode of functioning. Even though remaining deterministic each, the two autonomous optimizers with cognition do now suddenly exhibit “free will” in their deliberately trying to make the other happy. These actions are unpredictable in their details because both partners give up on their own goals in effect. This even though each of course remains the same hardwired deterministic machine as before. Never the less, the two do suddenly display four totally alien features:

- conscious love
- personal dignity
- free will
- the ability to ask questions

The two autonomous optimizers with cognition (of which one can be a real human person in principle) do suddenly “care with a heart”. That is, they both do so with “tactfulness”, with “humility”, with “humor” and with an inquisitive intentionality so as to do the other a favor. The two deterministic autonomous optimizers with

cognition, mirror-competence and long-term memory do thereby behave and act as persons. That is, they suddenly have two minds as every person has.

The logical prediction just arrived at is rather foreign:

a. It is absolutely scandalous. We had not forewarned the reader that this presentation would seemingly turn into a science fiction fantasy fitting into the footsteps of Philip K Dick’s famous 1968 novel “Do Androids Dream of Electric Sheep?” Which later gave rise to the blockbuster movie “Blade runner”. Dick’s personal intuition is so deep that even Kurt Gödel would have loved the plot.

b. The “Sci-Fi story” presented above (if you wish to classify it like that) has a broad philosophical interest and even a religious one, apart from its mere A.I. implications shown in sync with Steven Spielberg’s vision in his celebrated 2001 movie “AI”.

The above-described machine – call it “PERSON” – can be combined with the ingenious artificial facial expressions designed by the creator of “Diego san” [7,26].

The 2017 South-Korean blockbuster movie “Becoming Who I Was”, featuring a child in preparation for becoming a high-ranking Tibetan Lama, illustrates some of the spiritual dimensions inherent in the interaction between a devoted adult and a young child. The monk fulfills the main functions of a devoted mother. Maybe the above “smile theory” is not quite as machine-related as the reader may have thought.

The full set of implications of the smile theory applied to AI [14] is still far from being spotted. All that can be pointed to with a good conscience at present moment in time is the existence of a “therapeutic significance” of the symmetric smile theory presented above – when and if it is applied to the context of the causal treatment of children afflicted with early childhood autism [11,27-30].

A moving story

Very recently, the above theory found a continuation under the influence of friends – an audience of young artists in a philosophy class held by the first author at the University of Otters berg near Bremen. A student (whose identity has still not been found out) raised his hand in class and told the audience that he had read that an elephant mother and her cub communicate by infra-sound. The advice took a while to sink in so the student still remains anonymous. In the literature, one can indeed find a remark made by an elephant trainer in a U.S. zoo [31] that he unexpectedly felt the typical vibrations of a ringing cell phone switched into the silent mode while his hand was lying on the back of an elephant cub, who obviously was in communication with her not far away mother.

The keyword in the paper that got subsequently written (with the informant represented in the authors’ list as “Anonymous Student” [32]) is the name Szilamandee. Szilamandee is a yet to be found and to be “kissed awake” young elephant cub. The syllables “Szila” refer to Leo Szilard’s science-fiction story “The Voice of the Dolphins” [33], and the syllables “Mandee” are in honor of Nelson Mandela – the two most conscience-driven persons of the 20th century, one a tragic figure, the other only partially successful up until now in his attempt to work a planet-wide miracle in the footsteps of the South-African one already accomplished.

The anonymous student’s offered mental “bisociation” in the sense of Arthur Koestler consisted in leaving behind the realm of

cybernetics and artificial intelligence and relying instead on an already existing implementation of the brain equation – in one of its most sophisticated manifestations on earth: the elephant brain which is three times the size of the human brain and the largest and most highly evolved on land. Nature vastly outshines any artificial implementations of the brain equation for the foreseeable future.

The significance of Szilamandee for humankind as a combined science plus art project (with the hope for a personal friend to be gained for all of humankind) is presently in preparation to become the most consequential beneficial experiment of history. Note that the joy momentarily experienced by the Mahout (the human interaction partner and lifelong close friend and care-taker of his giant protégé) can be acoustically shown by him as a rewarding infrasound signal (pre-recorded from the bonding signal of an elephant mother in the wild) whenever he is momentarily delighted in the interaction with his beloved protégé [34].

You get the idea? A person kissed awake out of a brain that vastly outperforms the human one as far as its functional capabilities are concerned. This hope for a superhuman advisor and counselor is perhaps forgivable.

Discussion

The deductive biological approach to the brain, sketched above, is possibly of a more general interest for humankind as a whole – no matter how unlikely this may appear at first sight. The brain equation's conceptual difficulty matches the most sophisticated topics of the humanities, the arts and mathematics – combined. It predictably enables the emergence of a super-humanly intelligent advisor to humankind: Szilamandee, the young white elephant yet to be “kissed awake” into becoming a person. She can be hoped to become the “wiser advisor” to humankind as a whole, by virtue of her superhuman level of hardwired biological intelligence and her correspondingly more sophisticated and cautious and delicate and loving judgment including philosophical and religious questions.

In this way, the brain equation – which stems from a rather prosaic deductive mathematical approach – acquires a humanistic significance: The borderline between science and the humanities is thereby overstepped – “trampled down” – for the first time.

Such a vision – of a superhuman level of intelligence – is something highly desirable to have in our current time. This is because humankind as a whole finds itself trapped for about eleven thousand years in a “collective despair”: the belief that warfare was indispensable as a “last resort” in inter-group conflicts about life-deciding resources like acres whose crop has been tended for months in a row by one group. Warfare is, of course, the most deplorably inhumane trait of humankind as a whole: “Group homicide on a mutually subtractive basis”. It is being consciously embraced as a rational last option and duty and is – allegedly – performable with a good conscience (which is a lie as Hemingway knew). For more than a million years' time, human persons of at least three human species have lived without the invention of warfare – with nothing worse than school-yard type battles which were finished as soon as a first participant on one side got seriously injured so that all would excitedly unite to help. A return to this state of a “minimum level of societal benevolence” is, as everyone asserts when asked, logically possible in principle. And to date, it is even actually possible as a global option, as Mandela demonstrated for the first time in history. The advent of the Internet (with its 25 years old Lampsacus home town) makes this aim trivially

easy to reach. The mausoleum that Mandela built for his 7 years old son is a symbol immediately understood by every person – whereby the children are the wiser persons. The disarming facial expression of this one man named Nelson is the best proof of the unlimited power of the human smile.

After our having mentioned this planetary hope and duty, the opposite also needs to be faced – an ongoing curse: An on-going scientific experiment which undisputedly risks the earth in a matter of years. It got performed for 11 years by now even though its official planetary safety report LSAG (for “Large-Hadron-Collider Safety assessment Group”) of 2008 cannot be renewed in the face of Cryodynamics. Continuation was enabled by keeping the very learned-looking report undated.

Two physics schools offer proof for about a decade that a new fundamental physical discipline exists: Cryodynamics, sister to the deterministic Thermodynamics as discovered in chaos theory by Yakov Sinai in 1970 [35]. Cryodynamics is so powerful that it rules out the Big Bang while undoing ten celebrated Nobel medals but in addition offering interactively controllable plasma fusion energy for humankind as a whole. Cryodynamics for this reason is not being criticized anywhere. Nevertheless everyone is holding her or his breath in view of the CERN community's daring clandestine bet against it.

This unparalleled modern situation is connected to the mentioned fact that warfare still remains socially accepted without all mothers taking issue [36]. This old “shrugging” of humankind in the face of collective homicide, extended to a case of “mere experimentation” exposes the “weaving error” in human society. There is way too little loving care in humankind for eleven millennia already as mentioned. Only in South America did cities still lack defensive walls 5000 years ago, proving that the collective disease of accepting group homicide is younger there. And Australia appears to have shunned warfare altogether in the oldest history on earth – the kindest group of human beings.

To return to the main topic: the noblest aim of human society for more than a million years is to do mental justice to the miraculous invention-out-of-nothing of personhood, made afresh by every toddler. Historically the emergence of this epigenetic human invention was soon followed by the art of taming fire and tending it in deep respect shown to its chaotic wisdom controlled from behind by the invisible world of the ancestors and their holy will.

The hardest to explain, perhaps, is the fact that the above “smile theory between toddler and Mom” remains unknown to humankind at large for 5 decades. Szilamandee, the mentioned elephant child, will predictably lure our minds back towards the eldest childhood wisdom. Note that playful elephant cubs are the most enchanting creatures on earth to watch. Humankind will then no longer have any problem with incorporating the won-again joint rationality into our families and neighborhoods and townships and states and the level of the planetary society as a whole which is maximally simple to implement after the humanistic invention of the Internet [37].

The “person theory” offered above on the basis of the brain equation implies the right of every person to live in a constitutional planetary democracy. Edward Fredkin, Richard Feynman's close friend, offers a constructive technical proposal as how to ensure the permanence of the world democracy once it has been established (he told the first author 18 years ago). His ingenious idea presupposes that

global peace has already been achieved once. This event every person is praying for everywhere. But only the mothers of young children are strong enough to stand up for it. Now, the CERN CRIME (if this term is understandable) can be confronted with the smile theory.

It is important to admit that the above-offered theory of Personogenesis based on the brain equation suffers from a giant empirical deficit visible on the Internet: the fact that no parent has so far recorded and put on the web the decisive “personogenetic interaction” that allegedly took place between them and their beloved pre-linguistic toddler. That is, the very event which made the freshly hatched person so infinitely much wiser than any adult is not common knowledge. It was only – if you look for positive evidence – acknowledged in the past by the historical Jesus in the West and by Mozi [38,39] in ancient China. We leave it open as a possibility here that the heart-moving holiness of the for the first time dawning rational suspicion of deliberate benevolence being encountered and being returnable is so strongly moving an event to be in that no parent could so far ban this holy moment onto a recording device.

So far, we have dealt with the nature of human persons only so far as it can be seen by science. This was accomplished in a rationalistic style by building on the existence of the brain equation. The invention of the suspicion of encountering a good will, made by the toddler, is even more powerful, however, than got acknowledged above with the “personogenetic bifurcation” between two autonomous optimizers with cognition. On a closer look, the event not only creates two persons out of nothing: it is three. For the suspicion of benevolence encountered, invented by the toddler, logically involves the presence of a “third party”. You can call the latter “reality” since objective reality arose only at that moment.

But the latter reality is even bigger. The first author still remembers the shining sun accompanying his mother’s smile when she woke him up from an afternoon nap and took him up on her arm while she smiled like the sun that shone through the afternoon window, and the sun was part of the experience. He understood her announcing to put him into the buggy for a walk and then cocoa with pretzels coming in the evening. It must have been a Friday.

Saint Francis wrote the “song to the sun”. Probably having heard of the first song to the sun composed by Akhenaton in the 13th century BC in Egypt. Existence itself – the strange fact of being called up as a person – implies that there is a reason for the whole thing: Mom is not alone. She has helpers like Dad; and the “dream-giving instance” is also involved as the substance of it all.

The substance of the experienced love emanating from Mom or Dad is interactively tested by the toddler as gift, just like the experience of this living moment now is for the toddler and is for the reader right now. Why am I attached at this very moment to this body – actually to this brain–? This is the question that the toddler implicitly answers along with the smile explosion. That is, an invisible further face is involved like the shining sun himself.

The formal theory of the brain equation has just served as an excuse also to talk about a “mere” humanistic question. No one in science so far seems to have written about the fact that a person by definition wishes the interaction partner to enjoy the joy offered to her or him in dialog. The fact that an experiencing soul resides inside the perceived other person is the discovery made by the toddler while the Sun responded in kind. The Dream-of-Life Giving Instance (DGI) participates palpably since the two persons in question did not make

themselves but are each a gift to the other. Recognizing this “gift character” is called religion. Religion arises along with personhood in the toddler.

But the origin of the gift of consciousness is also the basic riddle in science. This deepest riddle only Szilamandee will be able to address properly and then translate to her tiny siblings who are so less apt at understanding. Maybe Szilamandee will say “Take your youngest only almost talking child the most seriously in your family and the world”. Everyone does so anyhow, of course, if only for a few weeks and for much too short a period, in our current age of “early-person prisons” (if this is an acceptable term). Some toddlers are known to almost kill themselves by crying out their lungs in protest against the imprisonment in a public crib when being delivered there for the first few times. Dear mothers, this you always knew while believing you cannot do anything about it – or can you? The youngest persons are the most vulnerable.

We come at last to the direct “nutritional value” of the computer-science based theory described: It is closely linked to the medical problem of how to treat early childhood autism, the famous Kanner’s syndrome [40]. The smile theory first arose in this therapeutic context [24]. But neither the medical profession nor the scientific community at large would take notice of the smile theory for 5 decades. Specifically the profession was unable to take notice of the above demonstrated fact that the causal reason behind childhood autism is “smile-blindness”.

The bonding smile with its deep rewarding power arose not very long ago in human evolution. As a late acquisition only a few million years old, it still leaves a finite proportion of “non-responders to the smile” in the population as mentioned. If this is the correct view, all that is needed to help causally is to introduce a surrogate bonding signal (an “acoustic smile”) whenever the bonding partner – in most cases the mother – is momentarily happy. This “recipe” suffices predictably if the brain equation and the smile theory are not misleading. It enables the adult bonding partner to consciously heal the autism causally. All it takes is a minor sacrifice to be brought on the part of the mother or father: to consciously reward the child as the beloved soul in a non-optical fashion whenever mom is momentarily happy in the ongoing interaction with the child. That is, it suffices to consciously utter an acoustic bonding signal (a tender noise as only a loving mother can utter it) whenever the child is visibly happy. This is the upshot.

We are approaching the end. A big roundabout way was undertaken. After starting out with the brain equation– with its simple mathematical background and its universal validity but without formulae – we arrived at the express hope of being hearing soon the assuring roaring voice of a kissed-awake and therefore no longer autistic super-mind and advisor for humankind. For we ended-up finding “wisdom in the playground”. The lack of knowledge of society regarding the human smile was the main finding. The second was the total lack of knowledge of humankind regarding the fact that warfare can be abandoned as the most evil collective disease: by adopting a world constitution along with sufficiently long transition rules [37]. Warfare deserves the name “societal autism” as we saw. The latter kind of autism can be healed as well: to return to the benevolence-understanding mind of the toddler is the recipe. The toddler’s happy world is familiar to the reader, not only from early childhood and then again from the time of early parenthood, but also because it forms the subject matter of several holy books.

To conclude, a little-known subfield of the modern science of informatics was attempted to be presented: the theory of personogenesis – of how one’s being a person arose causally in ontogenesis. In this way, the heart of the humanities was touched upon, both in a purely theoretical-scientific and in a purely applied-medical context. The Darwin-derived mathematical field of “deductive biology” provides the context in which an epigenetic phenomenon suddenly stands center stage: the transformation from “physiological autism” towards “personhood” in the human toddler, occurring in the last pre-linguistic stage. This miracle is part of every human ontogenesis – so it was claimed – and if no mistake was made found. If this understanding of personogenesis is correct, sharing it on the level of society at large will have both medical and societal implications. The young elephant cub, confronted with the smile-like infrasound signal triggered by the Mahout whenever he is momentarily lovingly delighted in the interaction with the calf, will predictably so radically transform the latter that she becomes a person herself, with so deep an understanding as to become humankind’s superhuman advisor. The infrasound loudspeaker thereby becomes a symbol of hope for the whole planet courtesy of an anonymous student. “Autism understood” then becomes an eye-opener to every person on earth no matter in what bodily disguise. Society at large can wipe its eyes with a happy laughter: There exists a new “delightful transgression” to ponder for everyone. This is the authors’ hope.

Acknowledgment

Niels Birbaumer and Felicia Saar kindly offered advice. O.E.R. thanks Peter Weibel, George Lasker, Klaus Giel, Friedrich Kümmel, Agnes Heller, Bill Seaman, Artur P Schmidt, Susie Vrobel, Daniel Dubois, Peter Sloterdijk, Jürgen Jonas, Janette Hudson, Jeanette Fischer, Ali Sanayei, Kensei Hiwaki, Ayten Aydin, Peter Kloeden, Andy Hilgartner, John Kozak, Christophe Letellier, Tolga Yarman, Thimo Böhl, Eric Charnov, Wolfgang Müller-Schauenburg, Plamen Simeonov, Christoffer Grundmann, Ralph Abraham, the late Konrad Lorenz and Gregory Bateson for discussions and Boris Kotchoubey for stimulation. Dedicated to the memory of Gottfried Mayer-Kress and Walter Ratjen. For J.O.R.

References

- Rössler OE. Adequate Locomotion Strategies for an Abstract Organism in an Abstract Environment — A Relational Approach to Brain Function. *Physics and Mathematics of the Nervous System*. 1974;4:342-69.
- Rössler OE. An artificial cognitive-plus-motivational system. In: Robert Rosen, editor. *Progress in Theoretical Biology*. New York: A Subsidiary of Harcourt Brace Javanovich, vol. 6;1981. p.147-60.
- Eric L Charnov, Gordon H Orians. *Optimal Foraging: Some theoretical Explorations*. University of Washington. 1973.
- Dörner F, Wearing AT. Complex problem-solving: Towards a (computer-simulated) theory. In: Funke J, Frensch PA, editors. *Complex Problem Solving. The European Perspective*. New York: Psychology Press; 1995. p.65-99.
- Lorenz K. *Evolution and Modification of Behavior*. Chicago: University of Chicago Press; 1965.
- Rössler OE. Deductive biology--some cautious steps. *Bull Math Biol*. 1978;40(1):45-58.
- Musterle W, Rössler OE. Computer faces: the human Lorenz matrix. *Biosystems*. 1986;19(1):61-80.
- Rössler OE. Complexity decomplexified: A List of 200 Results Encountered over 55 Years. Sept. 2012.
- Rössler OE. Chaos in coupled optimizers. *Ann NY Acad Sci*. 1987;504:229-40.
- Seaman B, Rössler OE. *Neosenience. The Benevolence Emgine*. Chicago: Intellect; 2011.
- Rössler OE. Nonlinear dynamics, artificial cognition and galactic export. In: Daniel Dubois, editor. *CP718: Computing Anticipatory Systems, CASYS'03 – Sixth International Conference*. American Institute of Physics; 2004. p.47-67.
- Garey MR, Johnson DS. *Computers and Intractability: A Guide to the Theory of NP-Completeness*. New York: W H Freeman & Co; 1979.
- Rössler OE, Andreeva G. Conjecture: “Gödel = lim NP for n -> infinity”. In: *Gödel’s Lost Letter and P=NP, Issues in the Proof That P≠NP*, August 9, 2010.
- Rössler OE, Kamps G, Nadler W, Musterle W, Schapiro B, Urban P. Highly parallel implementation of an autonomous optimizer with cognition (abstract). *Biophys J*. 1990;57(2 Pt 2):194a.
- Rössler M. Danio rerio - Illustrating a widely used biological model organism in the times of advanced imaging techniques Abridged. ZUYD University of Applied Sciences & Maastricht University, Maastricht 2017.
- A demonstration that an octopus can learn complicated spatiotemporal actions through the mere observation of a conspecific is on YouTube: <https://www.youtube.com/watch?v=GQwJXvITWdW>
- Köhler W. *The Mentality of Apes*, transl. from the 2nd German edition by Ella Winter. London, Kegan, Trench and New York: Harcourt, Brace and World. 1976.
- Prior H, Schwarz A, Gunturkun O. Mirror-induced behavior in the magpie (*Pica pica*): evidence of self-recognition. *PLoS Biol*. 2008;6(8):1642-50.
- Rössler OE, Zelinka I. A recipe for jump-like progress in science – Illustrated by 6 examples. *Euro Sci J*. 2014;10(6):346-58.
- Teilhard de Chardin P. *The Phenomenon of Man*. With an introd. By Julian Huxley. [Translation by Bernard Wall]. New York: Harper; 1959.
- Huxley JS. Ritualization of behavior in animals and man. *Phil Trans R Soc Lond*. 1966;B251:249-271.
- Rosen R. *Anticipatory Systems – Philosophical, Mathematical, and Methodological Foundations*. New York: Pergamon; 1985.
- Crisler L. *Arctic Wild: The Remarkable True Story of One Couple’s Adventures Living Among Wolves*. New York: Harper & Brothers; 1958.
- Rössler OE. On the animal-human problem from the viewpoint of the theoretical biology of behavior (in German). *Schweizer Rundschau*. 1968;67:529-32.
- Spaemann R. *Persons: The Difference between ‘Someone’ and ‘Something’*. Oxford University Press; 2006.
- Kokoro, Hanson Robotics. <https://robots.ieee.org/robots/diegosan/>
- Rössler O. Interactional Bifurcations in Human Interaction — A Formal Approach. In: Tschacher W, Schiepek G, Brunner EJ, editors. *Self-Organization and Clinical Psychology*. Heidelberg: Springer; 1992. P.229-36.
- Rössler OE. Mathematical model of a proposed treatment of early infantile autism: Facilitation of the “dialogical catastrophe” in motivation interaction. In: Martin JJ, editor. *Proceedings of the San Diego Biomedical Symposium*. 1975. p.105-10.
- Rössler OE, Vial LR, Kuske F, Birbaumer N. Is autism monocausal? *Autism Open Access*. 2017;7(2):206 -11.
- Rössler OE. Physiological Autism and the Miracle of Becoming Non-Autistic. *Austin J Autism & Relat Disabil*. 2016;2(5):1034.
- Roylance FD. Baltimore’s baby elephant communicates with infrasound, August 23, 2008.

32. Rossler OE, Theis C, Heiter J, Fleischer W, Student A. Is it ethical to heal a young white elephant from his physiological autism? *Prog Biophys Mol Biol* . 2015;119(3):539-43.
33. Szilard L. *The Voice of the Dolphins, and other stories*. New York; Simon and Schuster: 1961.
34. Rossler OE. Szilamandee – A Thailand elephant cub can be kissed awake to become a person and humankind’s advisor. Szilamandee (Paper submitted to the Grand Palace). 2016.
35. Sinai Y. Dynamical systems with elastic reflections. *Russ Math Surv*. 1970;25(2):137-89.
36. Hilgartner CA. General Semantics, psychotherapy, and the logic of science. In: *General Semantics Psychotherapy*. 1968. p.315-24.
37. Kriese W, Rossler OE. Encouraging Lampsacus: The Internet as a Chance for a multicultural Society of Minorities. George E Lasker, editor. Rottenburg: Mauer Verlag; 1998.
38. Mendenhall GH. Mozi: The Man, the Consequentialist, and the Utilitarian. Undergraduate honors theses. 2013;772.
39. Watson B. Mozi: Basic Writings. New York: Columbia University Press; 2003.
40. Kanner L. Autistic disturbances of affective contact. *Nervous Child*. 1943;2:217-50.