

Twenty Years of Generalized Quantum Theory

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Since the appearance of the first work on a “Generalized Quantum Theory” (GQT) twenty years ago now, this topic has occupied me continuously.

The prehistory of the GQT is the following. It started with a joint paper with Harald Walach (Walach & Römer, 2000), which pointed out the importance of the quantum theoretical figure of complementarity for consciousness research. After this work I felt that much more could and should be said about the application of quantum theoretical terminology beyond physics. This led me to draft the axiomatic framework of a “Weak Quantum Theory”, which became the basis of the first publication (Atmanspacher et al., 2002) describing and motivating the axiomatics of GQT and proposing various applications. Harald Atmanspacher, whom Harald Walach and I had invited and asked to participate, was also actively involved in the elaboration. Because of possible misunderstanding of the name “Weak Quantum Theory” we now prefer the name “Generalized Quantum Theory”: The GQT is weaker than the physical quantum theory, in so far as its axioms contain fewer presuppositions, but stronger, in so far as its range of application is thereby greatly extended.

Two reasons have mainly motivated me to set up the GQT:

First, the conviction, already held by Niels Bohr, that the quantum-theoretic figure of complementarity had fundamental significance far beyond the realm of physics. This idea has subsequently been pursued by many authors, but I was struck by the fact that such attempts either remained trapped in verbal parables or immediately explored an extended applicability of the full Hilbert space formalism of quantum physics. This seemed excessive and inappropriate given the applications I had in mind, especially with respect to another motivation for formulating the GQT:

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Second, the thoughts of C. G. Jung and Wolfgang Pauli on “synchronicity” and Pauli’s vision of a “new physics”, which would allow inner experience, non-reproducibility and gestalt to come into their own, should be given an appropriate formal framework. The GQT is a conceptual core of physical quantum theory, in which, by renouncing specifically physical parts of the quantum-physical formalism, quantum-theoretical terms like “state”, “observable”, “complementarity” and “entanglement” are nevertheless formally well-defined and applicable far beyond the realm of physics.

Since its first formulation, the axiomatic framework of GQT has undergone only very minor changes. First, in the work (Lucadou et al., 2007) on the synchronistic theory of so-called paranormal phenomena, the assumption, actually already implicit and provable in physical quantum theory, that entanglement correlations cannot be used for transmission of information or for controlled causal action, was elevated to an explicit axiom NT (“non-transmission”). Second, the rather technical assumption that “observables operate on states”, which appeared in older publications on GQT but was nowhere needed, was weakened to assume this only for propositional observables. What this means is explained in Filk and Römer (2011), in various chapters of this book, and especially in the more formal concluding chapter 14.

In many lectures and essays over the years a rather extensive body of thought has developed. On the one hand the most diverse applications of GQT, also to the theory of “paranormal phenomena”, are examined. On the other hand it is explored what consequences the quantum theoretical view of GQT has for world view, natural philosophy and epistemology. This is especially an urgent concern because the prevailing physical-reductionist worldview, despite all its successes, is increasingly perceived as incomplete, insufficient and even dangerous in its one-sidedness.

For this book I have selected twelve German-language essays from the environment of the GQT and in some cases clarified and updated them a little. In addition, the references have been brought up to date, merged and placed at the end. It is true that the English publications on these topics have found wider circulation and resonance, but at an older age I still liked to take the liberty of writing in my native language. There has been a lot of positive response to the GQT, besides rejection and lack of comprehension from the naturalistic-reductionist side. For example, the synchronistic interpretation of “paranormal” phenomena has been taken up many times. It is not possible here to go into more detail about the reactions to the GQT in the professional literature. If you want to get more information, you can search under the names of D. J. Bierman, J. R. Busemeyer, Markus Maier, E. Pothos, D. I. Radin and P. Uzan. In Germany, apart from my “fellow combatants,” especially the Munich group around Markus Maier has taken up considerations of GQT, not only on synchronicity, but also on the role of time as a human existential, as it is especially presented in chapters 8, 9, and 10 (Maier et al., 2016). The

philosopher Markus Gabriel from Bonn has entered into an intensive dialogue with me about GQT and mentions it positively in his natural philosophy publications (Gabriel, 2020; Gabriel & Eckold, 2019).

It is with a somewhat heavy heart that quite often cited English essays on applications of GQT to tilt pictures and questionnaires were left out, in which an extended formalism of GQT allowing quantitative statements is used. Tilt pictures are graphic representations that can be seen and interpreted in two different ways, so that perception jumps back and forth between the two possibilities. Familiar images may include the old woman and the young woman, the duck and the rabbit, or the Necker cube, which can be seen from diagonally above or diagonally below. In the work, this behavior was modeled and linked to the so-called “quantum Zeno effect”. A well-confirmed relation between the involved physiological time constants could be derived (Atmanspacher et al., 2004, 2008). Incidentally, tilt figures were well known to Niels Bohr through his friend, the perceptual psychologist Edgar Rubin, and it is very likely that they played a role in establishing the concept of complementarity. In the work on the questionnaires, the dependence of the probability of answers on the order in which the questions are asked was successfully modeled (Atmanspacher & Römer, 2012 and references therein).

Given the chosen conception of this book, it is inevitable that there will be a lot of repetition in the discussion of GQT in the various chapters. This is an advantage rather than a disadvantage. First, it makes the chapters more independent of each other and readable in any order. Secondly, experience has shown how difficult it is for readers trained in the world-view of classical physics to understand the basically simple terminology and way of thinking of quantum theory. We hope that constant repetition will gradually transform alienation into familiarity.

The description of GQT in detail will not be pre-empted in this introductory chapter. We only want to mention a few decisive basic features of every quantum-like theory, which we will encounter again and again in the following.

Of paramount importance are the terms *measurement* and *observation*. What is meant by this, also in accordance with contemporary epistemology, is something I like to call the *phenomenal character of the world*: World is given to us only as observed and insofar as and as it appears to us on our inner stage. On the other hand, we are of course part of the world and cannot simply observe it from the outside. Observer and observed are separated from each other by the *epistemic cut*, which in quantum physics is known as the *Heisenberg cut*. The position of the epistemic cut is different in each case when the observation is directed at the moon, one’s own hand or one’s own mental state, but it can never be made to disappear completely.

Equally important is the figure of *facticity*: the result of an observation/measurement is factual, which is also shown by the fact that an immediate repetition of the same measurement

will certainly yield the same result again. The choice of observation is at the discretion of the observer, but the result is not at the observer's disposal. The questions to the world can be chosen, but not their answers. This fact, which is too easily underestimated from a constructivist position, could be aptly described as the *recalcitrance of the world*.

The third property, which is particularly characteristic of quantum theories, is *uncertainty*: even with complete knowledge of the state of an observed system, the result of an observation is generally not predetermined, but undetermined. At first, the result of the last measurement is certain. But if another observation is made afterwards, its result is in general undetermined, and if the first observation is repeated afterwards, its result is generally undetermined again. The factuality of the first observation result has therefore been destroyed by the other observation. In this sense, there is an incompatibility of different observables, which is called *complementarity*. The standard example from quantum physics is the complementarity of location and momentum variables. The more precisely the location of a moving body is known, the more uncertain is its momentum (which is the product of mass and velocity) and vice versa. (For macroscopic bodies, however, even with very precise location and momentum determination, the indeterminacy is numerically too small to be perceivable.)

Complementarity, as we see, means nothing less than an epistemologically highly significant restriction of simultaneous predicability. It is not possible simultaneously to assign or deny with certainty all of the possible properties (accidentals) of a substance without mutual restrictions.

Since, due to the quantum-theoretical indeterminacy, a measurement generally changes the system state, measurement in quantum theory, in contrast to classical theory, not only has a registering but also a generating role. A measurement does not simply register a fact but rather the facticity of the result is created by the very act of measuring, albeit without control over the result.

With the completion of a measurement, potentiality has generally passed into facticity.

A creative act as a solution to a creative problem bears more than an external resemblance to a quantum-theoretical measurement process. Here, too, there is freedom in the choice of the problem, recalcitrance in the lack of firm control over the result and transition from potentiality to facticity. In addition, the result of creative acts depends on their sequence.

Finally, it should be emphasized that complementarity is an experimentally well demonstrable property.

Complementarity in quantum theories entails further important consequences, of which we would like to point out two in particular:

The first is the *non-existence of the orbit*. In order to follow the path of a microscopic moving body precisely, one would have to know its location at all times. However, this would also determine the velocity as the change in location at any time, which is impossible because of the complementarity of location and momentum. In general, it is not possible to measure the change of a quantum state. On the contrary, because of the facticity of the measurement result, one can “nail down” the state of the system by rapidly repeating measurements of always the same quantity. This fact is known as the *quantum Zeno effect*. The non-existence of the orbit also corresponds to the impossibility of precisely following a creative process through all its intermediate stations.

Even more important is the occurrence of *entanglement*. This phenomenon is so bizarre for an understanding trained on classical physics that Einstein in his well-known work with Rosen and Podolski wanted to use it to reduce quantum mechanics to absurdity (Einstein et al., 1935). Incidentally, the very appropriate term “entanglement” was coined by Erwin Schrödinger. In the meantime, entanglement has been experimentally proven beyond all doubt thousands of times, and there are already technical applications. The Nobel Prize in Physics for 2022 was awarded for successes in entanglement research.

In quantum mechanics, entanglement is generally explained with the help of Hilbert space tensor products. However, a precise analysis within the framework of GQT shows that the reason for entanglement lies deeper, namely in the possible complementarity of global observables, which refer to a system as a whole, and local observables, which belong to subsystems. If the value of a global observable is known and factual, then the values of local observables are generally undetermined. However, characteristic *entanglement correlations* occur which allow conclusions to be drawn from the measured values of local observables at one subsystem to the measured values of local observables at the other subsystems.

Entanglement correlations can demonstrably exist over very large distances without any time delay. Like complementarity, entanglement is easily accessible experimentally. Importantly, entanglement correlations do not arise as a consequence of causal influences of measurements on one subsystem on the other subsystems, nor can they be used to exchange information between subsystems. This can be explicitly proven for quantum mechanics (chap. 3) and, as mentioned above, is also required for GQT as “Axiom NT” to avoid severe paradoxes.

It is an important message of quantum theory worth keeping in mind that understanding cannot be gained only by demonstrating causal mechanisms of action, as is often tacitly assumed under the impression of the successes of Classical Physics. Entanglement is not a causal mechanism, but rather a holistic phenomenon of order. The different parts of a system enter together into the non-causal context of a gestalt-like pattern of entanglement.

The first four of the twelve essays presented in this book deal with applications of GQT.

Chapter 2 first contains a precise explanation of the entanglement phenomenon in quantum mechanics and GQT and then a whole number of examples of entanglement in non-physical contexts where one would not have expected it.

Chapter 3 is dedicated to the synchronistic theory of so-called paranormal phenomena. Parapsychological research often goes down the strangest paths in the ever frustrating search for sometimes obscure causal mechanisms to explain paranormal phenomena. Here the synchronistic message is liberating, that such mechanisms are not needed at all, if one interprets these phenomena as “meaningful coincidences”. Coincidental because they are not causally conditioned, meaningful because they make a sense in the context in which they are embedded. After what has just been said, it is natural from the point of view of GQT to interpret them as phenomena of entanglement. The axiom NT gains decisive importance here. At first it seems to contain only the assertion of an impossibility, but on closer examination it leads to positive consequences in accordance with experience gained with paranormal phenomena. Moreover, strategies for the planning of successful psycho-paranormal experiments are suggested.

In psychosomatics chapter 4, after an overview of different concepts of “soul” in the philosophical tradition, we propose not to separate the psychic and the somatic too sharply from each other, but to regard them as related to different, partly complementary observable variables for a unified system “human being” in the sense of the GQT. Diagnoses such as “psychological” or “somatic” have a fact-generating character as “measurements”, which points to a special responsibility of the person making the diagnosis.

Chapter 5 “Consistent and inconsistent histories” focuses on the mentioned phenomenon of the “non-existence of the orbit” in quantum theories. It first presents the “consistent histories” formulation of quantum physics and then it is shown how this can be transferred almost effortlessly to GQT. After that, the way is clear to discuss the principal difficulties that arise when documented, temporally marked facts are to be strung or “threaded” together into coherent histories. We illustrate our findings with examples from different fields.

A second group of five papers deals with philosophical and epistemological consequences of GQT, a question very close to my heart.

Chapter 6 “Inside and Outside” revolves around the epistemic cut. Following reflections on body and skin as the boundary of the body, we show that the boundary between inside and outside is just as shiftable as the epistemic cut and that in some cases inside and outside are virtually interchanged. We conclude with an interpretation of the difficult late poem “Gong” by Rainer Maria Rilke, which evokes the “inversion of spaces”.

Chapter 7 is about creativity and the dialectic of “finding” and “inventing”. The classical theory of inspiration sees the source of creative achievements outside and the creator as a mouthpiece and mediator. In contrast, the notion of free creativity places the source entirely within the creative individual. After a consideration of divine and human creativity, we establish a mediating position oriented towards GQT. Crucial here are the above-mentioned inner relationship between the measuring process and the creative act and considerations on the epistemic cut, in the vicinity of which the origin of creativity is located.

Chapter 8 contains reflections on physical and internal time. Process ontology (Whitehead, 1919, 1920; Rescher, 1996, 2000) considers itself an alternative to the classical ontology of persisting substances by focusing on temporal processes, transitions and change. First, the problem is described in detail and Zeno’s paradox is introduced, according to which one cannot think of a flying arrow as being both in motion and in one place at all times. GQT allows for a mediating position between both ontologies and a resolution of Zenon’s paradox. It is true that time appears in GQT primarily only as the internal time of the observer. However, it is possible to define a time-observable T and to distinguish between time-compatible observables that commute with the observable T and process observables that are complementary to T . This complementarity yields the solution to Zeno’s paradox and leads towards a neutral ontology embracing the substance and process ontology. The narrative “Tlön, Uqbal and Orbis Tertius” by J. L. Borges, serves us to demonstrate where a one-sided process ontology can lead. Finally, we speculate about energy-like process observables and “acategorical, meditative states” as “eigenstates” of process observables.

Chapter 9: The concept of emergence is often employed in the name of a softened physical reductionism. Beyond a certain threshold of complexity, surprising new properties are supposed to emerge in physical systems, possibly in several stages. The ontological status of the emergent level remains more or less secondary and subordinate compared to the basic level. First of all, a lot of conceptual clarification and definition work has to be done in connection with different versions of the concepts “emergence” and “supervenience”.

Three questions come to mind in this context:

- First: What is the more precise ontological status of the emergent level compared to its base?
- Second: What about the novelty value of the emergent?
- Third: How are causal influences of the secondary emergent level on the primary one possible? This problem is sometimes referred to as “Kim’s dilemma” (Kim, 2003). For orientation, we first describe a number of examples of more or less successful applications of the emergence principle.

In the spirit of GQT, the following point of view suggests itself: The additional properties arising together with increasing complexity are not really new, but contextual: concepts that already existed before become applicable and significant. In the language of GQT, this means that additional observables gain relevance, which can be compatible with or complementary to the old ones. Kim's dilemma dissolves from this point of view. The new observables only bring into play other aspects under which a system can be considered. A subordinate ontological status of the new observables does not exist, and a hierarchical order along the lines of "physics, chemistry, life, consciousness" need not be given in all circumstances. The rest of Chapter 9 deals with Darwinian evolutionary theory, in which emergence appears as a process in time. From our point of view, chance is not necessarily blind in Darwinian evolution, but perhaps also meaningful. We reject the claim of the "evolutionary epistemology" of the superiority of the naturalistic-reductionist world view as the victorious result of the successful evolution of the human cognitive apparatus.

Chapter 10 "Myth and Symbol" has an epistemological and ontological objective. There is an immense variety of practical and philosophical attempts by human beings to gain orientation and a minimum of control in their world by storytelling and symbolising. Some of these will first be presented in preparation for what follows. The GQT takes the already mentioned "phenomenality of the world" as one that appears in observations fully seriously. How the world appears to us is essentially to be described by a series of *existentials* by which the way of our existence as conscious and cognizing beings is determined. We deal with some of these in detail. Two of them are particularly central in our context: First, *temporality*: world does not appear to us as a panoramic painting, but rather in the manner of a film in which a window of the "now" moves into the future, leaving behind past. Secondly, "*facticity*". We live not only in a world of possibilities, but even more in a world of sometimes very hard facts. In GQT, time and facticity really emerge only in the context of a human observer. In this chapter, I venture further than usual in ontological speculation by sketching an ontological scenario of a timeless quantum world of possibilities. The consequences are dramatic.

Symbols and myths differ in their reference to time: symbols are largely timeless, while myths take the form of narratives. Finally, in the concluding last section, we try to show how symbol relations, myths and rituals are to be understood as attempts at world orientation within the framework of our designed ontological scenario.

The last three chapters are an expression of a dispute with the currently very widespread position of "naturalism", which could also be called physicalist reductionism. Naturalism holds the view that the world can and should be understood and mastered essentially as a large physical system. Also and especially from the perspective of GQT, weaknesses and contradictions of such a world-view are pointed out.

Chapter 11 deals with a much acclaimed book by S. Hossenfelder, which argues that in physics research the pursuit of beauty is misleading and calls for the courage to be ugly. After a few discussions on aesthetics, based in particular on Friedrich Schiller's definition of beauty as "freedom in appearance", the beauty of physical theories is observed by means of examples and the reason for it is examined. It is shown that the beauty of a physical theory cannot be separated from its truth and only stands as a reward at the end of physical research, a reward, which can, of course, act as an incentive beforehand.

Chapter 12 is an examination of the much praised bestseller *Homo Deus* by Y.N. Harari, who in some sense belongs to the environment of Californian transhumanism. This movement, supported by large corporations such as Google, works in the spirit of physical naturalism with energy, confidence, vision and some idealism on the enterprise of human improvement. With the enormous resources of future technologies, especially with the use of artificial intelligence, man is to become more intelligent, happier, stronger, healthier, even immortal.

First of all, Harari's theses are reported with extensive quotations and then subjected to a philosophical and epistemological critique, also in the spirit of the GQT. They are not at the height of contemporary philosophical reflection, ignore, much to their detriment, the rich philosophical tradition, and inadmissibly identify a modeling of certain features of the world with the whole of the modeled, and exhibit internal contradictions.

Finally, chapter 13 is entirely devoted to a critical examination of physicalist naturalism. It begins with a definition, as precise as possible, of what is to be understood by "physicalism". This is followed by six examples of physicalist conceptions of the world by physically competent authors. We then point out questionable presuppositions, epistemological errors and internal contradictions of every physicalist world-concept. In particular, in our view, the denial of any freedom of will even destroys the conditions for the possibility of truthful theorizations. We conclude by pointing to possible non-physicalist world models that satisfy the formulated demands.

In the last chapter 14, newly written for this book, I first give a more complete account of the axiomatic formalism of GQT. In doing so, I fulfill a wish that I otherwise had to deny myself in my not directly technical works. In a second part, which also contains new material, I investigate the possibilities of extending the formalism of the GQT step by step to the full Hilbert space formalism of quantum mechanics through a structural comparison of classical mechanics, quantum mechanics and GQT. For this section, if not mathematical knowledge, then at least an increased willingness to engage with mathematical ways of thinking and conceptualization is assumed.

Before we get down to business in the following chapters, I conclude this introductory chapter by expressing the hope that some of the joy I have felt in my work on the GQT will be transferred to the reader.

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