Too Many Conceptions of Time? McTaggart's Views Revisited

Brigitte Falkenburg & Gregor Schiemann

in: Gerogiorgakis, S. (ed.), */Time and Tense/*. Basic Philosophical Concepts (Philosophia: Munich, forthcoming).

Abstract: John Ellis McTaggart defended an idealistic view of time in the tradition of Hegel and Bradley. His famous paper makes two independent claims (McTaggart 1908): *First,* time is a complex conception with two different logical roots. *Second*, time is unreal. To reject the second claim seems to commit to the first one, i.e., to a pluralistic account of time. We compare McTaggarts views to the most important concepts of time investigated in physics, neurobiology, and philosophical phenomenology. They indicate that a unique, reductionist account of time is far from being plausible, even though too many conceptions of time may seem unsatisfactory from an ontological point of view.

Content:

John Ellis McTaggart defended an idealistic view of time in the tradition of Hegel and Bradley. His famous paper makes two independent claims (McTaggart 1908): *First,* time is a complex conception with two different logical roots. *Second*, time is unreal. To reject the second claim seems to commit to the first one, i.e., to a pluralistic account of time. Here we compare McTaggarts views to the most important concepts of time investigated in physics, neurobiology, and philosophical phenomenology. They indicate that a unique, reductionist account of time is far from being plausible, even though too many conceptions of time may seem unsatisfactory from an ontological point of view.

1. McTaggart's A-, B-, and C-Series

It is well known that McTaggart distinguishes two series of positions in time: The A-series is the "series of positions running from the far past to the near past to the present, and then from the present to the near future and far future"; and the B-series is the "series of positions which run from earlier to later" (McTaggart 1908, 457). The A-series corresponds to our experience of past, present, and future, as view from whatever present moment. The B-series neglects the tenses, and seems to come close to a Leibnizian view, according to which time is nothing but the order of successive events. McTaggart emphasizes that the B-series is not sufficient for the constitution of time, because the terms for "earlier" and "later" stem from our knowledge of the A-series. Moreover, the A-series is necessary for the constitution of time.

In addition, McTaggart introduces the non-temporal C-series, the "series of the permanent relations to one another of those realities which in time are events" (McTaggart 1908, 460). The C-series is obtained from the B-series by stripping off the temporal aspect of the order of events, i.e., the arrow of time. He claims that together with the C-series, the A-series constitutes time. According to this claim, the conception of time has two independent logical roots, the tensed A-series and the untensed C-series.

McTaggart's famous argument for the unreality of time runs as follows. The terms of the A-series, i.e., the tenses past, present, and future, must be either relations or qualities. Both assumptions, however, run into contradiction. If we take for granted that the terms of the A-series are relations, the resulting relational account of time is inconsistent: Either the relations are non-temporal, i.e., a relation of an event to something outside of time, since only the present may function as a term of relation that is in time. Or the terms of the relation are incompatible, given that time involves change, and change implies that any event is all the same past, present, and future. McTaggart argues that the latter difficulty also arises if we consider the terms of the A-series to be qualities: Since the A-series runs from past to present to future, any event of it is all the same past, present, and future, which can not be the case. He concludes that the A-series is contradictory and that any attempt to avoid the contradiction gives rise to an infinite regress of A-series.

McTaggart does not accept the most obvious way out of the paradox, namely to take the tenses that constitute the A-series for primitive terms. His main objection against this solution is that primitive terms should not give rise to contradiction, when applied to reality (468 f.). He concludes that neither time nor the A-series nor the B-series really exist. For him, the only way out of the paradox of time is the assumption that time is an illusion. Finally, he suggests that most probably only the non-temporal C-series is real. This view comes close to Einstein's view that time is an illusion (Einstein 1955) and the related modern view of a "block universe" (Barbour 1999).

Is McTaggart's argument conclusive? To our opinion, it is not. Without going deeper into this widely discussed topic (see Markosian 2008 and the literature given there), we make a simple and straightforward logical point. In order to prove that the terms of the A-series are contradictory, McTaggart presupposes the ontology of relations and qualities. That is, he argues in terms of first-order predicate logic. Since first-order predicate logic is non-temporal, this gives rise to contradiction and vicious circles. His discussion of the A-series misses the specific features of time or change, namely of coming into being and passing away. In order to explain the qualities of past, present, and future, and the relation of successive events (one of which only exists at a given time), he employs predicates and relations that he attributes all the same to all positions in time, as if these positions would co-exist. In doing so, he does not consider the possibility that the ontology of relations and qualities is incompatible with the specific character of time and tense. In order to avoid any contradiction arising from this incompatibility, the logic of time has been developed. This extension of first-order predicate logic introduces additional primitive terms which are based on the tenses, e.g. in analogy to modal logic (Prior 1956).

Given that there is another logical option which does not necessarily give rise to contradiction, McTaggart's claim of the unreality of time turns out to be a metaphysical rather than a logical result. In the following, we will disregard this metaphysical claim and focus on the first claim of his paper: The conception of time has two independent logical roots, namely the A-series and the C-series, which only together constitute time and give rise to the B-series.

Modern science, too, shows that there are various conceptions of time. It is far from being obvious whether they may be reduced to a unique, unambiguous conception of time. McTaggart's argument may be taken against a reductionist account of time. In order to investigate this question, we compare his approach to insights into the nature of time from physics, neurobiology, and philosophical phenomenology. Let us start with physics.

2. Objective Time and the Laws of Physics

Objective time is real time. This means that it is supposed to be neither illusionary nor a mere appearance of our consciousness. Objective time is world time, and it has been measured for many centuries by more or less precise clocks. A good clock works in a standardized way according to the laws of physics and it is synchronized with other clocks. Hence objective time is the time of physics.

In physics, tenses play no role. Physical theories are tenseless. They are based on mathematical differential equations. In the latter, time is the parameter on which the evolution of a physical system depends. *Prima facie*, the time of physics neglects McTaggart's A-series. It describes an order of events or system states which corresponds to McTaggart's B-series and/or or C-series.

We may leave it open whether the positions in the B- or C-series are concrete physical events or abstract positions in absolute time, corresponding to Leibniz' relational view or Newton's substantivalism (Earman 1989), respectively. Both options have in common that the arrow of time is inherent to them. They correspond to McTaggart's B-series, not to his C-series. Leibniz' relational time is the temporal order of successive events (Leibniz/Clarke 1715/16). Newton's absolute time runs from earlier to later temporal positions of the world in absolute space (Newton 1687). Both views presuppose the temporal order of events or positions in time, that is, the arrow of time.

Where does the physical arrow of time come from (cf. Zeh 2007)? The deterministic theories of classical physics have no arrow of time. The laws of mechanics and electrodynamics are reversible or time-symmetric. Their time-mirrored counterpart is also admitted by the laws. The boundary conditions of the corresponding differential equations may be chosen in the past as well as in the future. According to the laws of mechanics, the present state of the solar system is determined by these laws and the mass, position, and velocity of the sun, planets, moons, etc., five million years ago as well as five million years from now in the future. It has been argued that for this reason the laws of physics do not describe causal processes, in contradistinction to the usual metaphysical intuition that causality is a strictly determined connection between cause and effect (Russell 1912).

In a deterministic theory, the arrow of time only comes into play by choosing the adequate *initial* conditions*,* i.e., boundary conditions which pick out solutions of differential equations that correspond to processes running from earlier to later system states rather than backward in time. Here, only the choice of the correct initial conditions provides for the temporal direction of the system evolution. The laws of classical physics describe many possible C-series of system states. In order to pick a "physical" B-series out of the set of possible C-series, the correct initial conditions have to be chosen. The choice of the initial conditions can not be derived from the theory alone but only from our knowledge about the temporal structure of the world. In electrodynamics, for example, retarded rather than advanced potentials are chosen in order to describe the propagation of electrodynamic radiation.

In this sense, the deterministic theories of classical physics, i.e., classical mechanics, electrodynamics, and Einstein's theories of special and general relativity, are tenseless theories. By means of choosing the correct initial conditions they are applied to the systems and processes of a temporal world. The choice of the initial conditions provides for the temporal order of events and there is no mechanism that explains or defines the arrow of time.

The arrow of time is usually explained by thermodynamics. Thermodynamic processes such as the dissolving of milk in coffee are irreversible. In a closed system they give rise to an increase of entropy. In a coffee room it does not occur that the milk and the coffee in the cup spontaneously segregate or that the coffee in the cup becomes warmer if it is not heated. The stages of thermodynamic processes are obviously ordered in correspondence to McTaggart's B-series. But where does the increase of entropy come from?

Usually the increase is explained in terms of statistical mechanics. A gas consists of extremely many molecules, and the molecules interact in such a way that the macroscopic state of the gas tends towards thermodynamic equilibrium. According to a famous theorem of Boltzmann (Boltzmann 1877), this is due to the collisions of the molecules in the many-particle system of the gas. However, the dynamics of the system is described in terms of classical statistical mechanics. At the microscopic level, the system evolution is described as deterministic and reversible. Hence it corresponds to McTaggart's C-series. Boltzmann's statistical model only predicts an average increase rather than an average decrease of entropy if the correct initial conditions are chosen. At the beginning of the process, the molecules must be uncorrelated. This so-called hypothesis of molecular chaos is necessary in order to get the correct arrow of time, i.e., the evolution from an earlier state of lower entropy to a later state of higher entropy. Hence, the macroscopic B-series of system states that tend towards thermodynamic equilibrium is due to a microscopic C-series *plus* the correct initial conditions that define the temporal order.

To pass from classical statistical mechanics to quantum statistics does not help either. Quantum mechanics is a probabilistic theory. It does not predict the result of a measurement at a single quantum particle such as an electron, or the result of a collision between the molecules of a gas. It only makes probabilistic predictions for many measurements or collisions. At the level of individual quantum events, the measurement results remain completely unexplained. At the probabilistic level of many quantum interactions, the emergence of a classical world is explained in terms of decoherence. Decoherence, in turn, results from the interaction of a quantum system with its macroscopic thermodynamic environment. Hence, quantum mechanics is far from explaining the arrow of time. Vice versa, the thermodynamic arrow of time is needed in order to explain the macroscopic results of quantum mechanical measurements and collisions. So far, thermodynamics is the only physical theory which defines the arrow of time and describes a B-series of successive system states.

Another arrow of time is inherent to the model of the universe, in physical cosmology.

Modern cosmology is based on Einstein's theory of general relativity, which is also a deterministic theory.[1] A cosmological model is given by a solution of Einstein's field equations. Physical cosmology avoids models with an exotic temporal structure permitting time travelling and its paradox consequences. The physical models are obtained by choosing appropriate boundary conditions. The crucial boundary condition for the temporal structure of the universe is the Copernican principle. According to it, our location in the universe, i.e., the spatial position of the Milky Way in the galaxy cluster to which it belongs, is not peculiar, i.e., not physically distinct from other parts of the universe. This means that all relativistic standard clocks in interstellar space run synchronously, measure the same relativistic time, and make it possible to define a common past of the universe. This past can either be infinite, as Hoyle assumed in hiss *steady state* model of the universe, or finite, as assumed in the current standard model of cosmology, the *big bang* model.

According to the *big bang* model, the universe began with an initial explosion, passed through an inflationary phase of extremely rapid expansion which later slowed down, cooled down and became transparent, developed its present structure of stars, galaxies, and galaxy clusters, and is now subject to accelerating expansion. In the far future, the distances between the galaxies will become so large that from the edge of our galaxy, the Milky Way, or the position of the solar system, no other galaxy will any longer be observable since light will have to travel longer from it to the Milky Way than the age of the universe then will be.

Obviously, this cosmological model tells us a *history* of the universe. This history of the universe runs from the far past to the nearer past to the present and to the future. Hence, current standard cosmology does not only employ an arrow of time, the temporal order of the B-series. In addition, it employs an A-series that runs from the *big bang* through 13. 6 billion years of past to the present and may be extrapolated to the future. Where does this A-series come from? It is neither explained by Einstein's field equations of general relativity (which are deterministic and atemporal) nor by the specific models chosen by boundary conditions such as the Copernican principle, the finite age, etc. The arrow of time of the *big bang* model and the corresponding B-series agree with the thermodynamic arrow of time. But the model contains no element that would pick out the *present*. The present, its temporal distance to the earlier stages of the universe, and the theoretical reconstruction of its past since the *big bang*, are based on astrophysical evidence, i.e., on the observations which the

[1] In contradistinction to classical mechanics and quantum mechanics, however, in general relativity time is no longer a parameter on which the dynamic evolution of the system depends. This gives rise to the problem of unification mentioned below in the last paragaph of this section.

astrophysicists make with their large telescopes. The present of the universe is predominantly defined by the contents of human experience.

Does this mean that the A-series is *merely* subject to human experience? No. The physicists have good reasons to believe that they tell an approximately true story of the universe. In particular, they have evidence such as the 3K cosmic microwave background radiation which they interpret as the present footprint of the far past inflationary phase of the universe. And they of course believe that the 3K cosmic microwave background radiation was already there before it was announced by Penzias and Wilson in 1965 in the very near cosmic past, as well as before any human civilization arose, in the less near cosmic past. Nevertheless, without human observers no one would state the present shape of the universe and its past stages. Epistemically, the A-series is an epistemic achievement of human consciousness.

The ontological basis of this achievement is widely discussed in the philosophy of science, ranging over various versions of presentism and eternalism. According to presentism, only the present exists, the past is gone, and the future is not yet there. According to eternalism, all times exist all the same. The ontology of the A-series is presentism, whereas eternalism may either be understood in correspondence to the B-series as a temporally ordered spatio-temporal world, or in correspondence to the C-series, as an atemporal world, the “block universe” mentioned above. Any of these ontologies gives rise to serious problems. Presentism raises the question of how it is compatible with a relativistic concept of simultaneity. A temporally ordered spatio-temporal world raises the closely related question of how the temporal order works in Minkowski space, where it is restricted to the light cone of the observer’s frame. Atemporal eternalism collapses into Einstein’s and McTaggart’s view that time is an illusion. One or the other of these options has to be chosen for the ontology of time, however, giving rise to similar problems as those discussed by McTaggart.

Let us summarize what physics knows about time. Physical theories are tenseless. No physical theory or model describes an A-series. Physics describes processes either in terms of a reversible dynamics, i.e., as a C-series, or in terms of an irreversible dynamics, i.e., as a B-series. According to the latter, the temporal order of the B-series is due to the irreversible processes of thermodynamics. There are no other candidates for the arrow of time than thermodynamics as a phenomenological theory of macroscopic processes and the time arrow of standard cosmology, which is in agreement with thermodynamics. At the micro-level, no hitherto known physical theory of physics is able to explain the arrow of time.

What is worse, the most straightforward attempt at unifying quantum theory and general relativity ends up with a completely non-temporal “dynamics” of the universe. The Wheeler-De Witt-equation obtained by quantizing Einstein’s field equations no longer contains time as a parameter.[2] The models of this equation describe the “block universe” mentioned above, according to which time is an illusion (Barbour 1999), in precise correspondence to McTaggart’s metaphysical claim that time is unreal. However, it is hard to see how the “block universe” may be compatible with a global thermodynamic arrow of time. If time is an illusion, the increase of entropy in the universe must be illusionary, too.

3. The Investigation of Subjective Time

Leaving the physics of time and the ontology of objective time aside, let us ask now what science knows about subjective time, the time we experience in outer und inner perception. It has the structure of the A-series. The present is what we perceive right now, the past is what we remember, and the future is what we anticipate. As an epistemic achievement of our consciousness, the A-series is generated by the human mind, irrespectively whether time is real or unreal. If time is an illusion, the illusion is generated by our mind, and science should explain how this is possible in a tenseless world. If time is no illusion, our mind generates the tenses in accordance with the real passage of time in our environment. In this case, a scientific explanation of our time experience may be useful for a better understanding of the A-series.

The neurobiology of time is based on time measurements in stimulus-response-experiments, on the one hand, and the testimony of test persons, on the other hand. The experiments measure the event times of a B-series, whereas the test persons report their corresponding perceptions of the relation of sooner and later, and in addition their perception of present, past, and future, which constitutes the A-series. Neurobiological research shed light on the following aspects of our time perception (Pöppel 1978, 1997a, 1997b):

The present of the A-series is not a mathematical point but an extended time period. It covers a time period of about 3 seconds, the so-called specious present. (Hence, the ontology of time has one conceptual problem less than McTaggart suspected.) The past of the A-series is encoded in our memory. Neuroscience distinguishes the short term, middle term, and long term memory, which are known to be located in different areas of the brain and to a certain degree work independently. (They can independently get lost, due to different kinds of brain damage). Our anticipation of the future is less investigated. Obviously, it is closely related to our intentionality, i.e., our

[2] It has to be mentioned that other apporoaches to quantum gravity have been constructed in order to circumvent this problem, e.g. loop quantum gravity. For an overview of the problems and the attempts to resolve them see e.g. Smolin 2001 or Weinstein/Rickles 2011.

capacity of making short-, middle-, and long-term plans. It is well known that animals have time perception and short-term intentions, too. But the epistemic achievement of the full-fledged A-series seems to be specific to human beings who are able to communicate their memories to each other and make plans for their future life.

The specious present is something like a conscious time window through which we perceive the world. Within the duration of 3 seconds, our mind is able to discriminate many events. Neurobiological experiments test whether events of a certain temporal distance are perceived as simultaneous, non-simultaneous, or successive, and in the latter case, what the test person estimates their temporal distance to be. Each of these kinds of perception has a different time scale. Acoustic signals with a maximum distance of 2 milliseconds and optical signals with a maximum distance of 10 milliseconds are perceived as simultaneous. Events of a slightly higher distance are perceived as non-simultaneous but without unambiguous temporal order, like the positions of McTaggart’s atemporal C-series. Events with a minimum distance of 30 milliseconds are clearly perceived as successive, i.e., the first one as sooner and the other as later, corresponding to the temporal order of the B-series.

Below the minimum distance of 30 milliseconds for successive events, our senses work with different velocities. Hearing manages to process the signals faster than vision. As regards the transmission of the signals to our senses, the speed of light is vice versa much higher than the speed of sound waves. Except in a distance of about 10 m, the visual and the auditive signals emitted by one-and-the-same object are recorded by our senses not simultaneously but at different times. However, if the perception times of the visual and the auditive signals do not differ by more than a few milliseconds, our mind is able to tolerate this temporal gap and to attribute the signals to one-and-the-same objects in our surrounding.

The specious present is full of successive events that we are able to perceive “at once”. In its duration of about 3 seconds, about 100 events fit which we may perceive as successive since they have the minimum distance of 30 milliseconds. Hence, our time perception is very complex. Far from being pointlike, the present of the A-series overlaps many successive events of the B-series. Our perception of the continuous time flow of the A-series is “course-grained”. It embraces a fine structure of events of the B-series, which we perceive with finite temporal resolution and discontinuous structure. The perception of the B-series consists of a hierarchy of temporal perceptions at different time scales with a lower bound of 2 milliseconds. The larger scale perception of the specious present belonging to the A-series is “coarse-grained”. Regarding the structure of our experience, our impression of the continuous flow of time of the A-series is a sensory illusion. According to the neurobiology of time, it stems from an unknown integrating mechanism that makes the “coarse graining” over the fine structure of temporally ordered events belonging to the B-series, which in turn contains small “grey zones” of C-series events with less than 30 milliseconds of temporal distance, which are neither perceived as simultaneous nor as successive.

After all, our impression of the unique, continuous time flow of the A-series is a construction of our brain and mind. The neuroscientists assume that several specific integration mechanisms are at work at different time scales in our brain. Their hierarchy must form a complex integration mechanism, which generates the impression of a unique time flow and constitutes our unique experience of the passage of time.

The results of the neurobiology of time fit in with Kant’s view that time is a subjective form of intuition, our “inner sense”, which for him is an apriori condition of the possibility of experience (Kant 1781/1787). And Kant’s assumption that our self is the integrating capacity of our consciousness is not refuted, as long as the latter is far from being explained.

In recent neurobiology, a popular candidate for the unknown integration mechanism is the simultaneous occurrence of oscillations in different brain areas. They are assumed to be correlated with our experience of the present, the activation of different parts of or memory, etc. However, a mere correlation is no *mechanism*, i.e., it does not give rise to a genuine mechanistic explanation. A mechanistic explanation has causal components which generate a higher-level phenomenon (Craver 2007). In the case of time perception, the integrating mechanism should consist of *physical* causal components which generate a *mental* higher-level phenomenon, namely our perception of the time flow. But neuroscience has no “bottom-up” explanation of mental phenomena in terms of neuronal phenomena, and hence no mechanistic explanation of the former (Falkenburg 2006, 2012). In particular, there is no explanation of the way in which the mind constructs the A-series out of B-series-like simultaneous and successive events and the atemporal C-series-like event order between them. No one knows how our perception of the passage of time according to the A-series is linked to the measured structure of time perception explained in terms of the B-series. This epistemic gap is a paradigm case of the explanatory gap between physical and mental phenomena (Falkenburg 2012, chapter 5). If it is true that the A-series can not be reduced to the B-series, as McTaggart claimed, the gap is not only epistemic (i.e., just due to the current stage of scientific knowledge) but rather indicates principal limitations of scientific knowledge.

Concerning the question of whether time is real or an illusion, we draw the following conclusion from the neurobiology of time perception. “The” time, in the sense of our experience of a unique and continuous time flow and as an unambiguous A-series, is a construction of the human brain and mind. How the brain brings this construction about is unknown and perhaps outside the reach of empirical science, given that scientific explanations are restricted to reconstructing B- and C-series in McTaggart’s sense only.

Perhaps only a weird ontological conception of the passage of time gives rise to the conceptual problems stated by McTaggart. If the A-series is a construction of our brain, there is no such thing as “the” time, at least not as an entity which is subject to our experience. Our conception of time is based on our experience of change, including the biological change of any organism from birth to death and our own course of life. Change is as real or unreal as the world we perceive, and time is the ideal measuring scale for all kinds of change within the world and the evolution of the universe as a whole. This comes close to an Aristotelian view of time, and if we want to be more cautious about questions of realism, to a Kantian account of the empirical reality of time. From this point of view, no ontological problems arise. Empirically, the passage of time is the totality of the temporal processes we perceive in terms of the A-series and order in terms of the B-series. In terms of presentism (which then seems to be the most plausible ontology of time), one may say that time is the (subjectively extended) present which is full of objective marks of the past. At this point of reasoning, let us pass from the ontology to the phenomenology of time.

4. Time in the Everyday Lifeworld

Philosophical phenomenology has put forward several conceptions of time. Most significant among these were Edmund Husserl’s study of the inner consciousness of time, Martin Heidegger’s analysis of the timeliness (Zeitlichkeit) of existence (Dasein) and the temporality (Temporalität) of being (Sein), Jean-Paul Sartre’s existentialistic concept of time, Maurice Merleau-Ponty’s work on the time structure of the body (Leib), and Alfred Schütz’s socio-phenomenological characterization of time perspectives. In this paper, we cannot give an overview of the leading theories, but we will exemplarily introduce the concepts of lifeworldly time and of world time. They take up Husserl’s, Schütz’s and Thomas Luckmann’s analyses of the lifeworld. We begin with the concept of lifeworldly time. It embraces several time perspectives (including some elements of world time) which are brought together by a common structure of experience. The physical concept of world time and its influence on lifeworldly time will be discussed in the next section.

It is typical of experience in the lifeworld that adult human beings direct their attention to non-professional ways of dealing with familiar objects and persons as they appear in outer perception. Lifeworldly experience does not demand special skills. Usually, it is limited to visible objects in well-known environments. As an experience shared with fellow human beings, it occurs mainly in private life where it is made as a matter of course. With these properties the various forms of lifeworldly experiences (i.e., lifeworlds in plural) segregate themselves from other types of experiences. Not part of the lifeworld (singular) in the ideal-typical sense that is intended here, are, e.g., the worlds of childlike play, dreams, religious experiences and also the professional sphere of science and technology (cf. Schiemann 2005, 89 ff.).

According to Husserl, the lifeworld is a world of perception in which time emerges from the subjective stream of consciousness as a “form of experiences” (Husserl 1969, 100). According to Schütz, whom we follow here mostly, the subjective experience of time is only one of several “time perspectives” in the lifeworld (Schütz 1973, 232) which the autonomously acting individual, together with her fellow human beings, adopts in order to act upon the objects of everyday use. Actions in the lifeworld “gear into the outer world by bodily movements” (ibid, 211f.). In their execution, subjective and objective time merge and are unified “into a single flux“ which Schütz calls the “vivid present” (Ibid, 216.).[3] Both, the design that precedes the action and the subsequent reflection on the results of the action belong to subjective time. During the physical effort, which is a person’s action, the subject is living along in its stream of consciousness and directs itself towards the outside world at the same time (Schütz 1973, 214). It experiences its actions both as expressions of its subjective spontaneity and as spatiotemporal events which as all “events in unanimated nature […] [can] […] be measured by our chronometers” (ibid. 215). Therefore, actions fall within objective time which exists independently of the subject and which, because of its potential universality, is called world time by Schütz and Luckmann (Schütz/Luckmann 1990 f., 73ff). “World time” refers to the time which is valid for the earth and which applies to the lifeworld and human history as well as being part of cosmic time. It has not only physical but also social and cultural aspects, and it guarantees the terrestrial comparability of external times.[4] As lifeworldly time, it is characterized by the tenses like subjective time. Hence it fulfills the conditions of the A-series, however, without thereby being sufficiently defined.

[3] The term “vivid present” is related to William James's “specious present” to which McTaggart refers. But, while Schütz stresses the link between the objective and the subjective present, the term as McTaggart understands it is unilaterally subjective, and he uses it as an argument for the irreality of time (McTaggart 1908, 472). For a neurophysiological study of the specious present, see section 3.

[4] For the term “world time”, see also Blumenberg 1979; Fraser 1988, 245f.; Dux 1992, 312ff.

Let us examine the structure of lifeworldly time more closely. Starting from the location of bodily presence (leibliche Anwesenheit), Schütz and Luckmann segregate the lifeworld into concentrically arranged operating zones. The core area consists in all of the things and persons upon which subjects can physically act by means of bodily movements. This zone of “actual reach” corresponds to the present tense. Beyond its horizon is the “world of potential reach”, which encompasses past and prospective, i.e., non-existent objects (ibid. 63ff.).

Subjective time and objective lifeworldly time are organized in the irreversible order of past, present and future. Due to the priority of the execution of action, the present has an outstanding significance. The individual’s actions aim at the present and happen in the joint presence of other members of the lifeworld. As the coalescence of subjective and objective time is distinctive of the present, the past and future events differ in subjective and objective time as follows. Individual memories and the aims of actions are subjective. The times in which ancestors lived, contemporaries who are not present in the lifeworld act, and descendants will live, are objective. As a potentially universal time, objective time in this context is historical. As a potentially universal time, objective time in this context is historical and, therefore, also irreversible (ibid, 73ff.) transcending the lifeworld as much as it links it to other types of experiences.

Subjective time and the objective time so far discussed constitute the main time perspectives in the lifeworld. Moreover, there are biological forms of time in bodily rhythms and natural time patterns that structure life, like the alteration of day and night or the succession of the seasons, as well as elements of the psychological and biographical time of individuals, not to mention social time (ibid., 75ff., 124ff.). In the sociological and historical discourse on lifeworldly forms of time, it is debated whether the structural elements of such forms are to be classified according to their cyclical or their linear content (Young 1988; Fraser 1988; Nowotny 1990).

Events which are regularly re-occurring, but do not happen reversibly in the physical sense, are cyclical. We experience them in natural processes as well as in our everyday life in the ways that the times of meals and public holidays are set. (McTaggart does not even consider this temporal structure.) In contrast, events that form an ordered series are linear. (McTaggart assumes only this form of time in his B- and C-series.) Examples are biographical time, which is segmented by a life plan or life phases, and social time, which is determined by future aims. To our opinion, familiar social relationships in the lifeworld are mainly founded on cyclical structural elements, while the linear contents transcend the lifeworld by, e.g., aligning our life spans in world time.

5. World Time

While we assume that the notion of lifeworldly time is relatively historically robust, we allege that there has been a change in the notion of world time which historically put it in distance to the lifeworld. In a fictional primitive state, lifeworldly time and world time were not yet segregated. By transcending the present life towards an increasingly distant past and future beyond our life span, world time escapes progressively from the perceptible horizon of experience. The increasing distance has its impact in the growing relevance of the non-lifeworldly properties of world time that contribute to the erosion of the context of experiences in the lifeworld.

Let us discuss the tense relations between lifeworldly time and world time with the help of the physical elements of world time. In the historical succession of the great paradigms of physics, Aristotle's views are the closest to the lifeworld (Cohen 1960; McCloskey 1983). As we have seen at the end of section 3, an Aristotelian concept of time indeed avoids McTaggart's conclusion that time is unreal. Historically, the beginning of the detachment of a time concept, which complies only with the C- and the B-series, from the context of experience compatible with the A-series can easily be traced in Newton's works. Even though the fundamental terms of Newton's mechanics tie in with lifeworldly experience, at the same time they constitute an idealization and generalization with which the physical time concept clearly sets itself apart from everyday specifications.[5] In the "Scholium" explaining the fundamental terms of mechanics in *Philosophiae Naturalis Principia Mathematica*, Newton says:

> "I do not define time, space, place and motion, as being well known to all. Only I must observe that the common people conceive those quantities under no other notions but from the relation they bear to sensible objects. And thence arise certain prejudices, for the removing of which, it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common.
>
> […] Absolute, true, and mathematical time, of itself, and from its own nature flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year." (Newton, 2003, 6)

[5] The relation between the notion of time in Newton's mechanics and in everyday lifeworld is similar to the one of the respective notions of space, cf. Schiemann 2006.

Newton’s absolute time is an ideal construct which has become ontologically independent. The “absolute”, and, at the same time, “true and mathematical” time flows “equably”, even if nothing else exists. The steady time flow presupposes an one-dimensional, linear structure which follows the B-series. A direction is determined for all time, but the sense of direction of the flow, as well as of the movements which take place relative to the flow, remain open. This corresponds to the invariance of mechanical laws with respect to time reversal, i.e., the structure of the C-series. Mathematically, Newton's time has a universal metric. All change is defined relative to it. Hence, it can be determined which events take place simultaneously at different spatial points (cf. Callender 2010).

Newton poses the lifeworldly notion of an independently existing, i.e., real, flow of objective time that is absolute. Further, he generalizes the simultaneity, which emerges from the lifeworldly focus on the present, to a universal concept.[6] The time of the lifeworld and Newton’s time differ in determining the direction and admitting of a mathematical treatment of time. Absolute time has cast off the irreversibility of the time of the A-series that is prominent in the lifeworld. While lifeworldly time is composed rather cyclically, Newton's time is linearly arranged. Metaphorically speaking, clocks (more exactly, clocks’ hands) show events which typically re-occur in the lifeworld. In contrast, for Newton they count an endless series of units of change.

The way in which the physical concepts of time have become absolute in the early modern period corresponds to the fact that Newton describes all empirical time measures not only as “relative” and “common” but also as “apparent” time. It is not only from Einstein's or McTaggart's perspective that the lifeworldly concept of time seems illusionary. It already begins to adopt the character of an illusion from the perspective of classical physics which forgets its origins in the lifeworld or rather abstracts itself from them.[7]

Applying the time concept of classical mechanics to events in cosmic dimensions has turned out to be problematic. However, the world time of globalized modernity does approximately map to a unified, linear clock-time. The global world time is independent of events and its local dependence is reduced to the different time zones. Terrestrial distances are relatively small and signals propagating at high velocities can cover them in the shortest times. This matter of fact gives the global

[6] Leibniz's concept of time is less abstract insofar as he stresses the ideal character of time and characterizes time by the earlier-later order of the B-series. The distinction of the present that is typical for the lifeworld is however lost here as well.

[7] For the separation of social and natural time in the early modern period, see also Elias 1984.

information transfer the marks of nearly boundless simultaneity. That does not only hold from a lifeworldly perspective when, for example, messages are transmitted to distant persons via telephone without any remarkable delay. In general, simultaneity makes the social, nation-encompassing coordination of actions possible which is necessary for the control of technical systems and the timing of economical processes.

The boundary-expanding and world-encompassing nature of modern world time is opposed to the local constituents of lifeworldly time, which are still present in the globalized economy. We have described the lifeworld as a common world of direct actions, which is confined to a context in which subjects can act on objects and persons in the reach of their sensory perception by moving their bodies, i.e., without technical aids. It is therefore an essentially local world, which is broken up by means of communication that do not require bodily presence. By embedding lifeworldly change into the simultaneously existing time regime of distant events, the world time makes the limitations of lifeworldly time relative. It lifts these boundaries whenever direct actions are furnished with means whose effects unfold far beyond the reach of sensory perception.

However, the temporal transgression and lifting of boundaries endanger the existence of the lifeworld only if they become usual, and if they threaten the natural rhythm of human life. There have always been means for bringing the effects of an action about in the lifeworld beyond its horizon. An example is an exchange of letters over large distances and long periods of time which brings the involved parties into a relationship that is similar to the lifeworld. However, modern technology supports the idea of predominant social relationships, which no longer require the bodily presence of the participants, take lifeworldly rhythm as disturbing factor, and, consequently, may no longer be classified under the term “lifeworld”.

6. Conclusion

We have compared McTaggart’s approach to various concepts of time from physics, neurobiology and phenomenology. His thesis that the concept of time has two independent logical roots reflects the difference between the human experience and the scientific conceptions of time.[8] We have analyzed the experience of time from the perspective of neurobiological research as well as in terms of phenomenological descriptions of lifeworldly time and world time. It resolves into a multitude of phenomena which have the tensed structure of the A-series in common but which cannot be organized under a uniform conception. The differences among subjective

[8] For the relation between scientific and lifeworldly experience see Schiemann 2013.

experiences of time, local inter-subjective times as they are experienced in the lifeworld and the opposed historical world time are too great. And too great are the abstractions of physics from these various times.

Physical theories are often understood as fundamental theories of time. Their subject areas reach from the dimensions of elementary particles to the whole universe. But up to the present day they are unable to provide a unified conception of time. On the one hand, it is distinctive of them that they lack the A-series, and, thereby, they are still unable to explain the human experience of time. On the other hand, physical theories of time are themselves distinguished by a fundamental contrast between theories of the world on the small and the large scale. Establishing the thermodynamic arrow of time through atomic and subatomic processes poses no fewer difficulties than does the unification of the subatomic quantum world with a cosmological world time.

A plural concept does greatest justice to this conceptual variety, one which acknowledges that the conceptions of time in the sciences and the lifeworld currently seem irreducible. By stressing the divergence of these conceptions, plurality directs itself against reckless unification. The danger of rash coalescence arises against the background of the growing significance of world time, and the increasing influence of scientific explanations which meet only the requirements of individual aspects of time.

However, in a certain respect plurality can be only a temporary solution. That the experience of time is not yet subject to an exhaustive scientific explanation is unsatisfactory not only for science but also for the lifeworld. Connected to the scientific concepts of time are cosmoplastic potentials whose orientating power is of substantial significance for the conduct of life. But they cannot be made fertile if they can no longer be correlated with the human experience of time. Obviously, McTaggart's view that time is only an illusion does not help here either.

Literature

Aristotle (1936): Physics. Engl. transl.: Aristotle's Physics. A Revised Text with Introduction and Commentary by W. D. Ross. New York: Clarendon Press, 1936.

Barbour (1999): Julian B. Barbour, The End of Time. The Next Revolution in Physics. Oxford University Press.

Blumenberg (1979): Hans Blumenberg, Lebenszeit und Weltzeit. Frankfurt a. M.

Boltzmann (1877): Ludwig Boltzmann, „Über die Beziehung eines allgemeinen mechanischen Satzes zum zweiten Hauptsatze der Wärmetheorie“. In: Sitz.-Ber. Akad. Wiss. Wien (11) 75, 67-73. Reprint in: L. Boltzmann (1902), Wissenschaftliche Abhandlungen Bd. 2, Leipzig: Barth, 116-122; and in: S. G.

Brush (ed.) (1970), Kinetische Theorie II: Irreversible Prozesse. Einführung und Originaltexte. Braunschweig: Vieweg, 240-247.

Callender (2010): Craig Callender, *Introducing Time*. London.

Carrier (2009): Martin Carrier, *Raum-Zeit*. Berlin.

Cohen (1960): I. Bernard Cohen, „Die Physik des gesunden Menschenverstandes". In: G. A. Seeck (ed.), *Die Naturphilosophie des Aristoteles*. Darmstadt 1975.

Earman (1989): John Earman, World Enough and Spacetime. Cambridge (Mass.), MIT Press.

Einstein (1955): Albert Einstein, letter of condolence to the family of Michele Besso.

Elias (1984): Norbert Elias, Über die Zeit. Arbeiten zur Wissenssoziologie II. Frankfurt a. M.

Falkenburg (2004): Brigitte Falkenburg, „Zeit und Perspektivität". In: J.Klose and K.Morawetz (eds.), Aspekte der Zeit. Zeit-Geschichte, Raum-Zeit, Zeit-Dauer und Kultur-Zeit. Münster: LIT 2004, 89-108.

Falkenburg (2006): Brigitte Falkenburg, „Was heißt es, determiniert zu sein? Grenzen der naturwissenschaftlichen Erklärung". In: D. Sturma (ed.), Philosophie und Neurowissenschaften. Frankfurt am Main: Suhrkamp, 43-74.

Falkenburg (2010): Brigitte Falkenburg, „Zeit und Naturalismus". In: G.Gasser und J.Quitterer (Eds.), *Die Aktualität des Seelenbegriffs. Interdisziplinäre Zugänge.* Paderborn: Schöningh 2010, 29-53.

Falkenburg (2012): Brigitte Falkenburg, Mythos Determinismus. Wieviel erklärt uns die Hirnforschung? Springer: Heidelberg.

Fraser (1988): Julius T. Fraser, Die Zeit: vertraut und fremd. Basel.

Gloy (2006): Karen Gloy, Zeit. Eine Morphologie. Freiburg.

Husserl (1969): Edmund Husserl, Zur Phänomenologie des inneren Zeitbewusstseins (1893-1917). Rudolf Boehm (ed.), Husserliana, Bd. X. The Netherlands.

Kant (1781/1787): Immanuel Kant, Kritik der reinen Vernunft. Auflage A (1781) und B (1787). Riga: Hartknoch.

Leibniz/Clarke (1715/16): Gottfried Wilhelm Leibniz and Samuel Clarke, The Leibniz-Clarke Correspondence. Edited with introduction and notes by H.G. Alexander. Manchester: Manchester University Press (1956, repr.: 1998).

Markosian (2010): Ned Markosian, "Time", The Stanford Encyclopedia of Philosophy, Edward N. Zalta (ed.), [http://plato. stanford. edu/archives/win2010/entries/time/](http://plato.stanford.edu/archives/win2010/entries/time/) [Winter 2010 Edition].

McClosky (1993): Michael McClosky, „Intuitive Physics". In: Scientific American 249, 122-30.

McTaggart (1908): John Ellis McTaggart, "The Unreality of Time". In: *Mind. A Quarterly Review of Psychology and Philosophy* Vol. 17, 457–474.

Merleau-Ponty, Maurice (1966): Phänomenologie der Wahrnehmung. Photomechan. Nachdr., Berlin: de Gruyter 2008.

Newton (1687): Isaac Newton, Philosophiae Naturalis Principia Mathematica, Londinum.

Newton (2003): Isaac Newton and Andrew Motte, Sir Isaac Newton's Mathematical Principles of natural philosophy and his system of the world, Andrew Motte (transl. in 1729), Florian Cajori (transl, supplied with appendix), Whitefish.

Nowotny (1990): Helga Nowotny, Eigenzeit. Frankfurt a. M.

Penzias/Wilson (1965): Arno A. Penzias and Robert W. Wilson, "A Measurement of Excess Antenna Temperature at 4080 Mc/s". *Astrophysical Journal Letters* 142, 419–421.

Pöppel (1978): Ernst Pöppel, "Time Perception". In: Held, R. / Leibowitz, H. W. / Teuber, H. -L. (Eds.): Handbook of Sensory Physiology. 8. Perception, Chapter 23. Berlin: Springer, 713–729.

Pöppel (1997a): Ernst Pöppel, "A Hierarchical Model of Temporal Perception". In: *Trends in Cognitive Sciences* Vol. 1, No. 2, 56–61.

Pöppel (1997b): Ernst Pöppel, „Grenzen des Bewußtseins. Wie kommen wir zur Zeit, und wie entsteht Wirklichkeit?“ Frankfurt am Main / Leipzig: Insel.

Russell (1912): Bertrand Russell, “On the Notion of Cause”. In: *Proceedings of the Aristotelian Society* (1912/13) No. 13, 1–26. Reprint in: Herbert Feigl and Max Brodbeck (eds.): Readings in the Philosophy of Science. New York: Appleton.

Schiemann (2005): Gregor Schiemann, Natur, Technik, Geist. Kontexte der Natur nach Aristoteles und Descartes in lebensweltlicher und subjektiver Erfahrung. Berlin/New York.

Schiemann (2006): Gregor Schiemann, „Zweierlei Raum. Über die Differenz von lebensweltlichen und physikalischen Raumvorstellungen“. In: E. Uhl/M. Ott (Hg.), Denken des Raums in Zeiten der Globalisierung. Stuttgart, 124-134.

Schiemann (2013): Gregor Schiemann, „Persistenz der Lebenswelt? Das Verhältnis von Lebenswelt und Wissenschaft in der Moderne“, to be published in: T. M. Schmidt and T. Müller (ed.), Abschied von der Lebenswelt? Frankfurt a. M.

Schütz (1973): Alfred Schütz, Collected Papers I: The Problem of Social Reality. Ed by M. Natanson and H. L. van Breda, The Hague.

Schütz/Luckmann (1990 f.): Alfred Schütz and Thomas Luckmann, Strukturen der Lebenswelt. 2 Bde. Frankfurt a. M.

Smolin (2001): Lee Smolin, Three Roads to Quantum Gravity. New York: Basic Books..

Weinstein/Rickles (2011): Steven Weinstein and Dean Rickles, "Quantum Gravity", The Stanford Encyclopedia of Philosophy (Spring 2011 ed.), http://plato.stanford.edu/archives/spr2011/entries/quantum-gravity/.

Young (1988): Michael Young, The Metronomic Society: Notes on Cyclical and Linear Time. Cambridge.

Zeh (2007): H.-Dieter Zeh, The Physical Basis of the Direction of Time. Berlin Heidelberg: Springer, 4th ed.