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Collecting Evidence for the Permanent Coexistence of Parallel Realities: An Interdisciplinary Approach

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Biography

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Collecting Evidence for the Permanent Coexistence of Parallel Realities: An Interdisciplinary Approach

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Abstract

This paper assembles an interdisciplinary ‘presumptive evidence proof’ for the existence of parallel worlds, hence supports physics in solving the interpretation problem of quantum mechanics by making use of theory and experimental findings from psychology, philosophy, and the neurosciences. It will demonstrate that two questions are closely intertwined: the question of whether an *actual free will* exists and the *interpretation of quantum mechanics* chosen. Specifically, the paper will argue that whereas there is no room for an actual free will if the *Copenhagen interpretation* of quantum mechanics (postulating the ‘disappearance’ of Schrödinger’s wave function and the appearance of a singular state under measurement) is adopted (the same is true with other interpretations involving a collapse of the wave packet), an actual free will is possible if specific versions of the *multiverse interpretation* are chosen. This point cannot be made directly. In fact, it can *only* be produced within the proposed, interdisciplinary ‘presumptive evidence proof’ for the coexistence of parallel realities. Finally, the paper tentatively suggests an ‘interpretation’ of the many-worlds interpretation that circumvents some of the ‘strange’ ontological implications that this perspective exhibits according to some of its previous interpretations and develops a view on how free choices might actually be made.

Keywords

Parallel realities, free will, consciousness, many-worlds interpretation of quantum mechanics, Copenhagen interpretation of quantum mechanics, time, decision making

Interpretation of quantum mechanics as an interdisciplinary effort

Numerous interpretations of quantum mechanics have been proposed, and the theoretically most coherent – but also most thought provoking – of them, the many-worlds interpretation by Everett-DeWitt (Everett 1957; DeWitt 1970, 1971), or any other, more recent version of the multiverse view, would have huge consequences for our worldview also outside physics. Building conclusive evidence for any of the multiverse interpretations within theoretical and experimental physics alone is rather hard or perhaps even impossible at this point. Therefore it is important to take into account theory and experiments also from other scientific domains that are of fundamental relevance in this regard.

Consequently, the paper is assembling a ‘presumptive evidence proof’ to go as far as possible with making the permanent coexistence of parallel realities plausible. Specifically, the paper crafts an interdisciplinary approach, predominately based on physics, psychology, neuroscience, and philosophy. In the center of the argument are considerations on *free will*. According to any version of the multiverse view, *different realities* permanently coexist. Whereas this view uncomfortably suggests that our everyday experiences are based on a somewhat limited (or at least incomplete) picture of the actual world, other interpretations of quantum mechanics also come at a price.

As the paper is going to argue, other interpretations of quantum mechanics such as the popular Copenhagen interpretation – postulating a ‘wave function collapse’ resulting in a singular reality – are inconsistent with the existence of an *actual free will*; whose proposed absence is intuitively rejected by most people outside science (Nichols 2011). Interestingly then, the line of arguments Hameroff (2012) quite recently presented in favor of an existence of free will in light of quantum brain biology will turn out to be partially related to the respective argument presented in this paper on the one hand. However, on the other hand, whereas Hameroff (2012) argues that the objective reduction modification of quantum mechanics (Penrose 1994; Hameroff and Penrose 1995) – a singular-universe approach – would also be able to ‘rescue’ free will, this paper will argue that the latter is only possible in the multiverse. More precisely, this paper will show that quantum mechanics *is* free will friendly, but only if we (a) allow for the permanent coexistence of parallel realities and (b) if specific ‘interpretations’ of the many-worlds interpretation are chosen. As our analysis is going to demonstrate, one of the existing multiverse interpretations (the EEC by Mensky 2005, 2007a,b, 2010) is indeed free will friendly. It will turn out, however, that this approach has strange consequences, ontologically, as any other of the existing multiverse interpretations to be analyzed in this contribution. Hence the paper will tentatively propose a new interpretation of the multiverse whose consequences might be seen as ontologically less irritating. The paper will finally address the question how free choices might be made, what it actually means to freely choose between alternatives in the multiverse.

The contribution is building up primarily on the seminal works by David Deutsch (Department of Atomic and Laser Physics, Centre for Quantum Computation, Clarendon Laboratory, Oxford) and Michael Mensky (Lebedev Physical Institute, Russian Academy of Sciences, Moscow), both very outspoken about their preference for a multiverse interpretation of quantum mechanics, and both publishing their thoughts in scholarly journals as well as popular science monographs (for the latter see, e.g., Deutsch 1997; Mensky 2010).

Regarding the contributions by Deutsch, the paper is sharing many of his thoughts on the nature of time (see the proof section of the paper, step 3). Other basic premises of the contribution are related to the work by Mensky, he himself mainly building up on the work by Squires (1988). According to Mensky (2010, 54), essential arguments against von Neumann's ([1932] 1996) reduction postulate, explicating the Copenhagen interpretation, "will be connected with the phenomenon of consciousness." Hence, the idea that only an *interdisciplinary treatment* may suffice in generating a convincing case for the many-worlds view can be traced back to the works by Mensky (e.g., 2005, 2007a,b, 2010).¹

The 'presumptive evidence proof' for many worlds is presented in a stepwise manner, as *pieces of a puzzle* that will finally form a coherent picture. The pieces of the puzzle are taken from different domains, mainly quantum mechanics (measurement/interpretation problem etc.), role of consciousness (in quantum measurement as well as in light of neuroscience findings), findings on/explanations of predictive physiological anticipation, and considerations on the possibility of free will (being at the core of the contribution). Interestingly, *within each of these domains* (i.e., quantum mechanics, free-will problem in philosophy, etc.) there are *alternatives* to treat or interpret the respective phenomena or theories, but the flexibility is gone when trying to form a joint perspective out of all those domains. Indeed, within each of those disciplines there is always just one approach that qualifies as piece of a puzzle appropriate to complete the picture. This idea is depicted in Figure 1.

The remainder of the contribution is structured as follows. In the next, main chapter, the paper will craft, in a stepwise manner, a 'presumptive evidence proof' for parallel existing realities. It ends with a long subchapter on free will and on interpreting the many-worlds interpretation in a form that is free will friendly and makes sense, ontologically. This chapter is followed by a chapter addressing the question how free choices are made in the multiverse. The final chapter contains a conclusion and remarks,

1. However, whereas Mensky's work is firmly rooted in the measurement theory of quantum mechanics, his psychological arguments are rather presented in the form of 'anecdotal evidence.' Instead, the goal of this paper is to push as much as possible towards a 'proof,' given the interdisciplinary knowledge we have. This requires being as specific, as rigorous with arguments from psychology, philosophy, and the social sciences as with those from quantum mechanics. Furthermore, this paper is going to reverse some of Mensky's arguments. What he sometimes postulates for the sphere outside physics, this contribution shall employ together with (additional) empirical or theoretical evidence in favor of the respective phenomena, to substantiate the parallel and permanent coexistence of multiple parallel realities.

it summarizes the results of the presented analysis, and speculates on what consequences the adoption of a multiple-realities perspective might have.

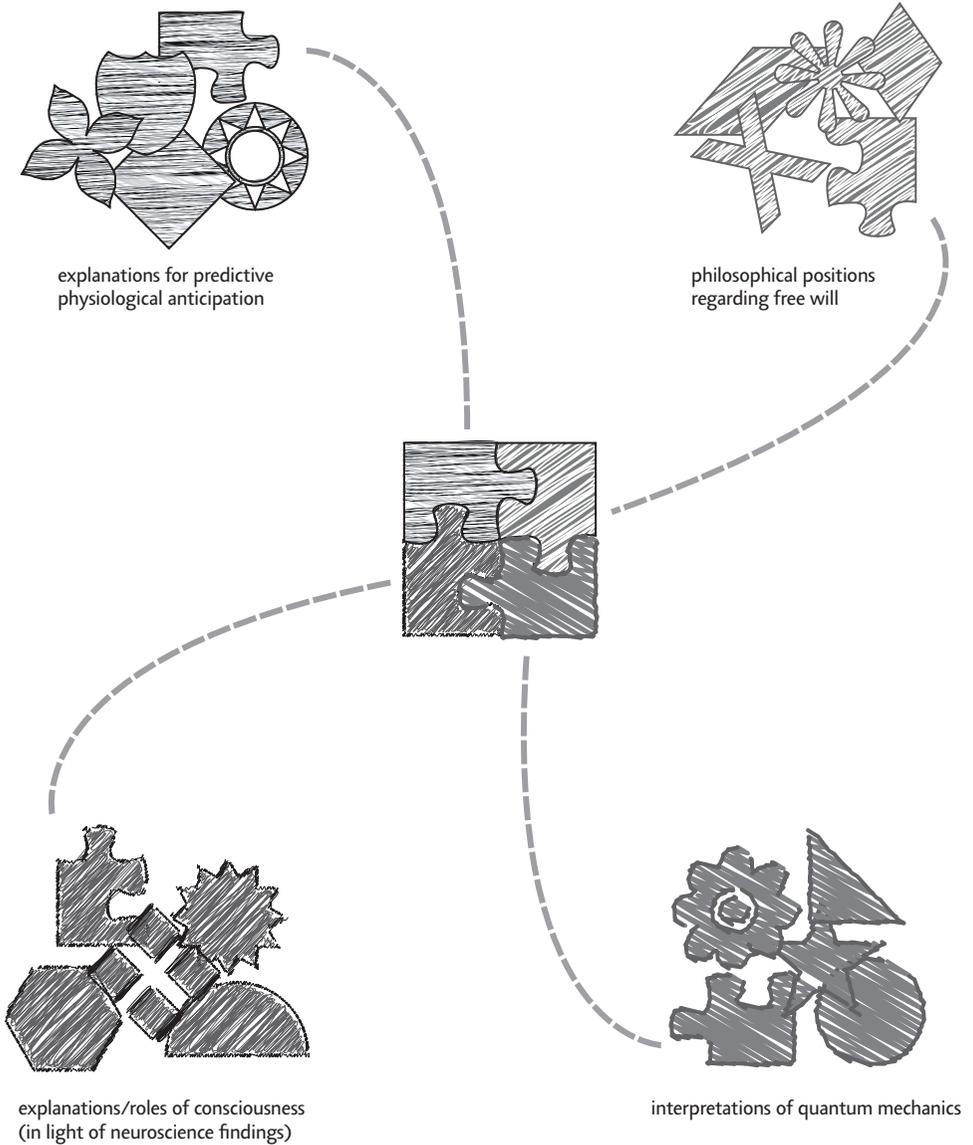


Figure 1: Structure of the interdisciplinary 'proof' of the multiverse

A 'presumptive evidence proof' for the coexistence of parallel worlds

Step 1: Many worlds as a convincing interpretation of quantum mechanics

Of the many possible interpretations of quantum mechanics (see, e.g., Auletta 2001), all being trials to address the so-called measurement problem,² the most well-accepted so far have been the Copenhagen interpretation³ (together with von Neumann's reduction postulate (von Neumann [1932] 1996)⁴) as well as the many-worlds interpretation, initially based on Hugh Everett (1957) and its further interpretation by Bruce DeWitt (1970, 1971).⁵ In this article, I shall mainly concentrate on those two; although the objective reduction formalism⁶ (Penrose 1994; Hameroff and Penrose 1995) will briefly be touched, and, as already mentioned, the many-worlds interpretation will again turn out to be interpretable.⁷ Dealing with other interpretations is beyond the scope of this article.⁸

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2. An important aspect of the measurement problem is the fact that measurement results achieved on some quantum system are uninterpretable without taking into account the consciousness of the observer. This turns out to always be the end of a logical chain of reasoning defining a measuring device, then defining the brain as evaluating the result shown on the measurement device, etc.
 3. The Copenhagen interpretation of quantum mechanics is the one most representative of something that might be called a 'quasi-Newtonian' worldview; it is that interpretation of quantum mechanics that challenges the validity of our everyday experience in the least radical way.
 4. For simplicity, whenever the paper mentions the Copenhagen interpretation, this (most prominent) version of it is meant.
 5. Within the academic community in physics, other well-known current or past proponents of the many-worlds interpretation are, e.g., David Deutsch, Murray Gell-Mann, Richard Feynman, Stephen Hawking, Michael Mensky, and Euan Squires.
 6. Since objective reduction changes the formalism of quantum mechanics, it is actually more than an interpretation.
 7. Examples for interpretations of the many-worlds interpretation are found in Albert and Loewer (1988), Mensky (2005, 2007a), Squires (1988, 1991), (Zeh 1970), Barrett (1999), and in various contributions to the Oxford University Press Volume *Many worlds?* (ed. by Saunders et al. 2012). The two main issues dealt with in those interpretations are the notion of probability and/or the distribution of consciousness between the parallel worlds.
 8. I am also not dealing with the description of the measurement problem via decoherence, since decoherence does not attempt to *explain* the measurement problem – and hence does not suggest an independent interpretation of quantum mechanics.

It appears to be hard to generate clear-cut experimental evidence within physics that can be interpreted in favor of either the Copenhagen interpretation or the many-worlds view.⁹ Bohr's complementarity principle, however, closely related to the Copenhagen interpretation and implying that physical entities may either behave as a particle or a wave but never both ways at the same time, got more and more undermined by experimental findings at the double slit.¹⁰ By using very clever experimental designs, some research groups (see, e.g., Mittelstaedt et al. 1987; Scully et al. 1991; Menzel et al. 2012) have demonstrated that it is possible to partially or fully keep the interference pattern (wave-like behavior) whilst nevertheless measuring the path the respective particle was taking. Whereas those findings are unfavorable for the Copenhagen interpretation, they are leaving the many-worlds interpretation untouched.¹¹ Indeed, in his 1997 popular science book *The fabric of reality*, David Deutsch seems to indirectly base his argument pro many worlds already on those novel findings. When discussing the interesting change of the interference patterns of a singular photon sent through four versus two slits even though the way of the photon through one of the slits can clearly be identified (Deutsch 1997, chapter 2), he leaves the possibility unmentioned which has been demonstrated in an overwhelming number of older experiments: that measuring the path of the photon would often *destroy* (or largely diminish) the interference pattern; and that only very clever experiments lead to the new type of results.

Sure enough, those novel findings at the double slit have not necessarily been interpreted in favor of the many-worlds view by other physicists. Just one, perhaps quite unspectacular example is a poster by Boscá Díaz-Pintado (2007) who discusses, in light of those novel findings, the necessity to change the formalism of quantum mechanics,

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9. The situation is unclear enough that David Deutsch and Michael Mensky, two vivid proponents of the many-worlds view on the physics side, disagree on the evidence presented within physics. Deutsch believes that the experimental evidence generated within physics is already in favor of the many-worlds view (Deutsch 1997, chapters 2 and 3). He even *identifies* quantum mechanics with, how he calls it, the *Everett theory* (Deutsch 2012). However, Mensky (2005, 2007a,b, 2010) argues that the evidence generated within physics cannot unambiguously be interpreted in favor of the multiverse view.
 10. The original double-slit experiment demonstrating the wave-like nature of light has been carried out first by Young in 1803, already; the first experiment of this type using electrons has been designed and carried out by Jönsson (1961). When carrying out those experiments and measuring the path of the electron (or of other particles) through any of the slits, the interference pattern normally gets destroyed.
 11. For another (hypothetical) way of potentially discriminating between different interpretations of quantum mechanics, see Deutsch (1985).

to formulate further assumptions, to modify the complementarity principle etc. Nothing more 'radical' is mentioned.

There are more reasons, however, for taking the many-worlds view seriously (and seeing the Copenhagen interpretation quite critically): Taking the linear Schrödinger equation literally, as a description of the actual world,¹² there is no need or even possibility to think of anything 'artificial' like a state reduction or collapse of the wave function to a singular universe. The Copenhagen interpretation, as convenient as it might be as a workhorse in applied physics, is just not parsimonious. The implied collapse of the wave function is 'alien' to quantum mechanics (Mensky 2005, 2007a, 2010, chapters 1 and 2).¹³

So it looks like if some evidence for the permanent coexistence of parallel worlds already evolves within physics, but skepticism regarding its potential to actually encourage a shift of paradigm towards a many-worlds view (both within and outside physics) is advisable. After all, shifts of paradigms require time and effort (Kuhn [1962] 1996). This is the reason why this article is proposing an interdisciplinary search for evidence for the many-worlds view.

Step 2: Role of consciousness in quantum mechanics –
not only important for the multiverse view

Many current theories of consciousness, e.g., many of the approaches proposed in psychology, are characterized by a reductionist approach where the work of consciousness is 'degraded' to some *specific cognitive operations*. Such type of theorizing (as well as the underlying empirical studies) would be categorized as belonging to the 'easy problems' regarding consciousness by David Chalmers (1995, 1996); whereas the 'hard problem' of

12. A more precise view on the Schrödinger equation, accepting human epistemological limits, would be saying that it accurately describes our *room of perceptual possibilities* (see also footnote 38).

13. Neither Deutsch nor Mensky consider it a problem applying the many-worlds perspective to macro phenomena, i.e., our life, whereas the experiments underlying the measurement problem as well as quantum mechanics itself have originally been conducted or developed, respectively, for the world of micro particles. I am sharing this perspective with Deutsch and Mensky. A stream of research that does *not* help with better understanding the micro-macro link, is the experimental work showing that quantum effects (i.e., systems being in superposition states) already occur with somewhat 'larger' objects, with atoms or even molecules (see Venugopalan 2010), or even visible objects under very low temperature (O'Connell et al. 2010). (To keep things clear, only the object, a micromechanical resonator, is visible with the eye, not the quantum effects themselves).

consciousness could be described by questions such as “why are some organisms *subjects* of experience?” or “why do *qualia* exist?”¹⁴

From the perspective of quantum mechanics, consciousness – in the second, ‘hard’ interpretation as sort of a *pure subjectivity* – plays a central role in the solution of the measurement problem (e.g., Squires 1988; Mensky 2005, 2007a; Stapp 2009). Quantum systems, including the measurement device etc.,¹⁵ are in a *superposition state* before any conscious observation is conducted; or in other words, a *unique result* or outcome of the measurement is – finally – determined whenever consciousness of the observer comes into play. Thus, paradoxes can be constructed such as Schrödinger’s cat or Wigner’s friend.¹⁶

The measurement problem is a fairly complex issue, but even trickier is the question as to how to make use of the effects of conscious observation in a multiverse ‘proof.’ The reason is that the role that the observer’s consciousness plays in the solution of the measurement problem can be interpreted differently, in turn favoring different interpretations of quantum mechanics or being related to changes in its formalism (examples):

1. Consciousness can be seen as the ‘force’ causing the *collapse of the wave function* hence favoring the Copenhagen interpretation (Stapp 2009).
2. Consciousness might be interpreted as the entity responsible for *separating between infinite ‘alternatives’ or ‘alternative realities’* (Everett 1957; DeWitt 1970, 1971).
3. Consciousness might also be *identified* with the *selection* of *one* subjective alternative (Squires 1988; Mensky 2005, 2007a,b, 2010).
4. And, based on the *objective reduction formulation* of quantum mechanics, there

14. The term *qualia* describes the individual’s conscious experience and is at the core of the mind-body problem. The term has first been defined in its modern usage by Lewis ([1929] 1956).

15. The view that measurement per se (by whatever device) is at the core of the measurement problem will not be supported here. There is no logical line that can be drawn between either the to be measured physical system and the physical measurement device, between the latter and the perceptual apparatus, between the perceptual apparatus and the brain etc.

16. Wigner’s friend is a thought experiment, an extension of the well-known Schrödinger’s cat consideration. Here, a friend of the principal investigator conducts a measurement at some quantum system for him, e.g., measures the outcome of Schrödinger’s cat experiment, whilst the principal investigator is absent from the laboratory. The question is when the outcome of the measurement is actually determined, only after the return of the principal investigator, or at a previous moment, e.g., when the friend has looked at the device but the principal investigator is not informed about the outcome, yet?

are approaches that link the action of consciousness to *processes in the brain* (e.g., Hameroff and Penrose 1995; Hameroff 2012).

Since nothing can be concluded at this point from the relation between consciousness and the measurement problem for the ‘presumptive evidence proof,’ the paper will look at the action of consciousness from a different angle, later, when the issue of free will is dealt with. The four exemplary perspectives just presented, however, share the view of consciousness being at the center of a process of ‘creation’ of subjective reality.

Step 3: Individuals’ bodies anticipate the future – and this only makes sense in the multiverse

This subchapter will report on evidence that people are able to anticipate the future. This *fact* is quite important for the multiverse ‘proof’ to be crafted in this paper because it makes a case against a linear flow of time with important consequences as demonstrated at the end of this subsection. The most conclusive evidence for this ability pertains to *body reactions*. The presented evidence has a close relationship with the findings by Libet and coauthors (e.g., Libet et al. 1982, 1983) as well as Soon and coauthors (Soon et al. 2008) that will play an important role in the next subsection.

In a large-scale meta-study on *anticipatory physiological responses*,¹⁷ Mossbridge et al. (2012) analyze a total of 26 reports published between 1978 and 2010. The authors find strong evidence for individuals’ abilities to physiologically anticipate unpredictable events (randomly ordered arousing vs. non-arousing stimuli or guessing tasks with correct/incorrect feedback), no matter what type of physiological measure was used: “electrodermal activity, heart rate, blood volume, pupil dilation, electroencephalographic activity, blood oxygenation level dependent (BOLD) activity” (1). In a fixed effects model, the overall statistical significance for predictive physiological anticipation turned out to be $p < 2.7 \times 10^{-12}$. The evidence is so clear, that (conservatively calculated) 87 unpublished contrary reports would have been necessary to reduce this evidence to chance ($p > 0.05$). Hence it is quite safe to conclude that individuals’ bodies are able to anticipate future developments.¹⁸

17. An example for this type of research is the study by Bierman and Radin (1997) where individuals’ electrodermal response significantly differed between emotional and calm pictures already before their presentation.

18. Interestingly, such ‘time-backwards’ effects have also been proposed as an explanation for some ‘strange’ behavior of particles (see, e.g., the experimental evidence reported by Herzog et al. 1995).

What does this imply in terms of physical theory? Is there any way of explaining such effects of the future on the present? And why is this evidence supposed to help with the 'existence proof' of parallel realities? The question one wants to ask here is "are there ways to think of time as something that does not just flow in the direction we would normally suppose, from past over present to future?"¹⁹ There are exactly two ways that physics has taken to deal with that question:

1. Scholars have intensively thought about how physical laws could be applied the 'other way around,' i.e., backwards.²⁰ There is one physical law, however, that seems to contradict such approaches because it appears not to be reversible: the second law of thermodynamics, i.e., the increase of entropy over time. If entropy increases over time, how could we possibly 'go back?' Time-reversing physical laws in a singular world, however, also runs into *logical paradoxes*, described in a graphic way in the form of the 'grandfather paradox'²¹ in the literature on time travel. Although time travel seems to be a different pair of shoes than physiological anticipation, *any effects* of anticipating the future potentially leading to changes in an individual's present behavior so that the respective future will *not be reached*, anymore, leads to the same type of paradox.²²
2. A second, more radical way is to question the idea of a flow of time altogether. Actually, this second approach should be judged as the theoretically convincing way, because it does not run into 'grandfather' type paradoxes. David Deutsch (1991) was the one who introduced a mathematical solution to this problem in his treatment of time travel (see also Deutsch and Lockwood 1994). Time travel does not lead to any logical inconsistencies *if* there are parallel universes.

19. For a systematic analysis of different physical theories regarding our subjectively perceived, asymmetric flow of time see Zeh (1999).

20. A good impression of this type of research can be gained by looking at the numerous theoretical and empirical contributions to *Frontiers of time: Retrocausation – experiment and theory* (ed. by D. P. Sheehan 2006).

21. In the grandfather problem, the time traveler goes back and kills his grandfather at young ages, actually before his father was conceived, so that the time traveler himself should not exist.

22. An important difference between the situation of the grandfather paradox and our situation is that the body of an individual does not have to be 'added' to some reality to change anything there, leading to the problem that mass would have to be either transferred to or to be 'produced' within this reality. For our case it is sufficient that consciousness is able to somehow connect to a reality where a 'replica' of ours already resides (see below).

Specifically, the logical inconsistency of traveling to and changing one's own past is solved by switching universes. After traveling to the 'past' and 'returning' to 'presence,' the time traveler resides in a new, parallel reality. As already argued above, this consideration of the potential effect of time travel is relevant for our case of anticipatory responses of the human body since changes in the body's reaction that prevent the foreseen future involve the same type of paradox. In his popular science publication *The fabric of reality*, Deutsch (1997, chapter 11) develops different times as special cases of other universes.

Hence, a logically consistent theoretical account for the possibility of predictive physiological anticipation by individuals is only possible on the basis of a permanent coexistence of parallel realities including the coexistence of parallel times. A graphic way of looking at both anticipatory reactions as well as our regular perception of a flow of time might be sort of 'lateral movements' of our consciousness between universes or realities or just 'locations.' Note that this is not to suppose that there is any novel, underlying physics needed for this. The underlying physics is the multiverse.

Interestingly, a *non-presentist* view, i.e., a view where the presence is not seen as the only existing state of the world, cannot solely be developed within the multiverse interpretation of quantum mechanics. The so-called *block universe* view, postulating a four-dimensional world with time as a *permanent* fourth dimension (additional to the three dimensions of space) was already proposed by Minkowski in 1908 (1952, 75) as a consequence²³ of Einstein's special relativity theory. Not surprisingly, then, because of the coexistence of multiple times, Minkowski also postulated the coexistence of multiple spaces:

We should then have in the world no longer space, but an infinite number of spaces, analogously as there are in three-dimensional space an infinite number of planes. Three-dimensional geometry becomes a chapter in four-dimensional physics. (*Ibid.*)

So the parallel existence of different times can be arrived at from different theoretical starting points.²⁴ But what about our subjective experience of moving along some linear

23. According to Petkov (2005), the block universe view is the only logically consistent consequence from special relativity.

24. Although the structure of reality derived from special relativity might look quite differently than the one derived from quantum mechanics. It is beyond the scope of this paper to explore those differences in more detail. It is also beyond the scope of this paper to concern itself with relativistic quantum mechanics.

time dimension? The fact that we are normally moving from one reality to another reality, where the second reality is perceived as a 'later' point in time might be seen as a 'convention of conscious experience' or 'perceptual convention,' perhaps rooted in culture. A different perspective on the same phenomenon would be Kant's view of time (Kant [1781] 1996, A30-2/B46-9 and A35-6/B52). According to Kant,²⁵

Time is not an empirical concept that is somehow drawn from experience. For simultaneity or succession would not themselves come into perception if the representation of time did not ground them a priori. Only under its presuppositions can one represent that several things exist at one and the same time (simultaneously) or in different times (successively). (A30/B46)

The coexistence of different times in parallel realities has an important consequence for the one remaining problem that has been put forward against the potential existence of time-backwards effects: The second law of thermodynamics would not be a problem for 'time-backwards' effects, anymore. In the case of parallel universes, i.e., if 'different times' coexist, different states of physical entities with respect to their entropy would also coexist. And if conscious beings were able to 'laterally move' with their conscious 'emphasis' between those versions of themselves, i.e., across different realities/parallel times, this would imply that they were also able to 'move' between different states of entropy, say, of different versions of their body. That in turn implies that consciousness would be able to also 'move' in the direction of lower entropy,²⁶ appearing as if the time arrow would have been reversed.

Summarizing this view, our perception of time could be described as taking 'snapshots' of different realities where some 'perceptual convention' or a priori category in the sense of Kant normally organizes them in the form of a unidirectional flow of time (for inspiring empirical findings on this matter varying the duration between 'snapshots' of various courses of action see, e.g., Gruber and Block 2012).²⁷ Since in principle other

25. Note that not only Kant offers a 'non-objective' account of time. Most idealist philosophers would agree with this basic notion. Of special importance for a 'non-objective' account of time are the thoughts by Leibniz (see, e.g., Grosholz 2011, 347–349), especially well articulated in the Leibniz-Clarke correspondence (Leibniz and Clarke [1717] 2000).

26. A similar line of reasoning is presented by Mensky (2010) to better understand the survival of living beings. He relates this to the 'anthropic principle.'

27. Hameroff (2012) gives an overview of different approaches and results underlining this idea.

points in time are always present, however, this opens the door for time-backwards effects.

Step 4: Free will can only exist in the multiverse

1. Structure of the argument

As already stated in the introduction, empirical results across different cultures demonstrate that most people intuitively believe to possess free will (Nichols 2011). Neuroscience however, seems to prove free will to be an *illusion* (see below). A majority of philosophers has chosen a compatibilist perspective (see, e.g., Dennett 2003), arguing that, under certain conditions, individuals can be held responsible for their actions even if an *actual* free will is absent.²⁸

The quite emotional debate about free will and responsibility that took place in the last decades originated in the well-known Libet-experiments (Libet et al. 1982, 1983; Libet 1985) suggesting that the measured readiness potential for a motor action was running ahead of the reported conscious decision. Whereas there has been a critical debate about how to interpret those findings, e.g., by John Eccles (1985),²⁹ most interpreted them as evidence for (a) free will being *impossible* and (b) subjective perception of possessing free will being an *illusion*.³⁰

The debate regained its vigor quite recently with technically more advanced neuroscience studies (Soon et al. 2008) where consciousness not only has been demonstrated to run *several seconds* after specific activities in the brain. But allowing subjects to actually *choose between two alternatives* (i.e., pressing a left or a right key), the authors were able to *predict* the respondents' choice for one of the alternatives based

28. Important other positions are different versions of incompatibilism denying the existence of responsibility under conditions of determinism. Another major position is libertarianism. The most well-known current libertarian is Kane (2003), building his argument pro free will on indeterminism consistent with the Copenhagen interpretation of quantum mechanics. It is unfortunately beyond the scope of this paper to provide a more thorough description and deeper analysis of those important perspectives. A detailed introduction to and discussion of different historical and contemporary perspectives on free will is provided in Walter (2001).

29. The question *how* consciousness might influence (material) brain activities is further analyzed by Beck and Eccles (1992).

30. Since the observed order of events in the experiments is: (1) readiness potential, (2) conscious decision, (3) action, Libet (1999) argued that consciousness might still be able to veto behavior. However, this argument has also been criticized. See, e.g., Velmans (2003) and Kühn and Brass (2009).

on *specific brain areas* that were activated before the conscious decision was reported. Or in other words, when a certain brain area would be activated, consciousness would make a choice for, say, left, a few seconds later, and after that the person would press the left key. The same would hold for the decision to press the right key, but with a *different brain area* activated ahead of time. So the fact that people think they are consciously deciding in favor of pressing a left or a right key simply must be an illusion, no? So how realistic is our perception of free voluntary acts?

In the following it will be argued that Libet's as well as the more recent neuroscience findings can actually be used to *justify* the permanent coexistence of parallel realities. A couple of introductory thoughts are necessary at this point:

- The paper is going to employ a teleological argument.³¹ It will be argued that possessing an actual free will gives our consciously experienced life, i.e., qualia, a purpose or meaning.³²
- The paper will then elaborate on why experiments of the Libet type and modern followers (e.g., Libet et al. 1982, 1983; Libet 1985; Soon et al. 2008) do not necessarily rule out the possibility of an actual free will in the sense of being able to choose A instead of B under identical internal and external causes.
- Later in this subchapter, it will then be discussed what interpretation of the many-worlds view could make free will *possible* and what their respective ontological consequences are. For this means, the paper will first briefly discuss how plausible the many-worlds interpretations are that have already been suggested by Everett-DeWitt, Albert and Loewer (1988), Squires (1988, 1991) as well as Mensky (2005, 2007a,b).³³ A novel interpretation that is free will friendly and ontologically more appealing than the previously suggested ones will also be proposed.

31. "Questions about teleology have, broadly, to do with whether a thing has a purpose or is acting for the sake of purpose, and if so, what that purpose is" (Woodfield [1976] 2010, 1). Teleological or so-called design arguments have, e.g., been crafted in favor of the existence of God (e.g., Aristotle [350 B.C.] 1999, 5–6; Plato [360 B.C.] 2000, Timaeus 28a-34b; Aquinas [1265–1273] 2006, 19) or to disapprove philosophical positions such as the solipsism (Kant [1781] 1996, B 39 et passim).

32. Dennett (1991) tackles the problem in a radically different way by arguing that qualia does not exist, a perspective that will not be followed, here.

33. Recent 'realist' perspectives (see Saunders et al., 2012) will not be discussed.

- Still on the way of completing the argument, the subsequent chapter will deal with the way *how* consciousness might freely choose between alternatives in the multiverse.

2. *Free will might not be an illusion if different times are parallel*

Regarding the existence of consciousness, a teleological perspective (see footnote 31) might lead to the following question: What could be the ‘reason,’ the ‘sense’ of being conscious in the basic meaning of *qualia* (the ‘hard-problem’ aspect of consciousness; Chalmers 1995, 1996), if there is not any effect of this basic feature of consciousness on our decisions whatsoever? Note that asking this question is inspired by two (related) convictions: (a) Consciousness is not a byproduct of physiological (brain) activity, because *qualia*, i.e., our conscious experience of life, are something *qualitatively* different from physiological processes.³⁴ (b) Consciousness is neither supervenient on the physical nor does it influence any physical processes. This is a radical departure from many well-known approaches (e.g., Lewis 1994), that, however, will become more transparent towards the end of this contribution.

Contemplating the question on the ‘meaning’ of consciousness, one is indeed tempted to conclude that consciousness might have the ‘sense’ of ‘producing’ something like a free will. Especially since the alternative perspective on *subjective experience*, watching of and acting in (with fixed roles) a technically advanced 3-D movie, with no possibility to change anything we see, is a view with hardly any teleological appeal.

But then, one might argue: “Nice thought, but how to rule out the argument put forward based on Libet’s and followers’ experiments? If consciousness is always running after the fact, free will simply *must* be an illusion, no?”

Here is my argument: The discussion in step 3 of my ‘proof’ lead to the impression that parallel realities might grant us (i.e., our consciousness) with the possibility of *laterally* moving between different times (because they coexist); this also being a theoretically consistent explanation for predictive physiological anticipation by individuals (or time-backwards phenomena in general) that does not run into paradoxes. Assuming the appropriateness of this explanation, however, it is only a small step to also assume that consciousness is able to make backwards-directed decisions, e.g., choose in favor of some motor actions ‘backwards’ – or better laterally – in time. This in turn would allow for a very different perspective on the Libet type experiments: The fact that

34. A detailed discussion of this important and controversial matter as well as an overview of the relevant literature beyond the ‘hard-problem’ analysis by Chalmers (1996) is not possible in this paper.

the experience of a conscious decision takes place *after* building the readiness potential for a motor action, or *after* observable activities in certain brain areas, would become meaningless for the free will debate.

3. Analyzing free-will friendliness and ontological consequences of different versions of the multiverse view

In this subchapter, some fundamental versions of the multiverse interpretation will be dealt with. They will all be analyzed regarding their free-will friendliness as well as their ontological consequences. A basic problem pertaining to all those multiverse versions is the question how to deal with the Born rule. Therefore the subchapter starts with this generic problem.

The problem with the Born rule: The Born (1926) rule, successfully used in practical applications of quantum mechanics for many decades and integral part of the Copenhagen interpretation provides specific probabilities for different measurement outcomes. For a multiverse perspective, this causes trouble in two regards: (1) How could one make any sense of probabilities in the multiverse, when in fact the Schrödinger equation is deterministic? How could the Born rule be derived within this framework?³⁵ (2) How could an actual free will possibly be established if probabilities of measurement appear to be governed by the Born rule?

1. The problem starts with the fact that it is generally unclear (also outside the multiverse view; see, e.g., Landsman, 2008) what exactly justifies the Born rule theoretically (empirically, its support is excellent). After decades of different approaches, a few scholars have quite recently pursued ways to derive the Born rule from *subjective* principles, either decisions (Everettian view: Deutsch 1999; Wallace 2012) or generalized probability theory (quantum bayesianism: e.g., Fuchs 2010). Both approaches assume the application of certain normative principles or axioms.
2. Since an individual may not necessarily be *obliged* to obey to either the rationality axioms proposed by Deutsch (1999) and Wallace (2012) or the generalized probability theory proposed within quantum bayesianism,³⁶ those

35. See also the discussion in Squires (1991).

36. Outside quantum mechanics, e.g., in economics and psychology, there are large research fields devoted to the understanding of deviations of people from rational decision principles (e.g., Kahneman and Tversky, 1979) or the Bayes rule.

approaches do principally open the space for free will; if, as assumed above, consciousness is not supervenient on the physical. But, given the excellent empirical support for the Born rule, is there actually any *room* for free will? The problem we seem to be facing here arises from a conflict between subjective and intersubjective perception.³⁷ Measurements carried out in physics as well as psychology laboratories are *reported* and communicated (that's the main point of carrying out scientific research in the first place); their results become intersubjective facts. The Born rule is such an intersubjective fact. If individuals' consciousness would *measurably* and *intersubjectively communicable* influence the observation probability of quantum outcomes in a straightforward and replicable way, this intersubjective fact would be violated. Instead, an individual's influence on developments might rather be expected regarding non-measurable, non-reported, fuzzy, and complex developments; or, in other words: with respect to the individual, personal or better *subjective experience of life*. E.g., meeting the perfect person to marry, as improbable that might objectively be, may (a) nevertheless happen and (b) never violate the Born rule because it can simply not be analyzed within its framework. Admitted, this poses some problems for a direct 'proof' of the existence of free will. This is not saying that it precludes clever experiments on this matter to be carried out in the future. But it helps understanding why evidence does not exist so far and why the existence of free will can only be suggested indirectly at this point, as is the case with the 'proof' of the multiverse (see again the introduction, especially Figure 1, for the underlying logics). The solution to the two problems is intertwined.

Opening the space for free will: EEC framework as a starting point: According to Mensky's (2005, 2007a) multiverse interpretation, the extended Everett concept (EEC), consciousness is indeed able to influence subjective probabilities so that preferred developments of the world are *perceived* with higher probability within the individual's subjective experience, but without changing anything in the *wavefunction*³⁸ (see also

37. For a related perspective see Mensky (e.g., 2005, 2007a; 2010).

38. Mensky (along with many others) would call the Schrödinger equation the 'objective wavefunction' associating the Schrödinger equation with the physical world (see also footnote 12). An important question is, however, whether or not the wavefunction is really objective. The Schrödinger equation might alternatively be seen as describing accurately our room of perceptual possibilities; close to 'objective' reality, but not identical with it. Since it contains a time dimension and individuals normally organize reality along the time dimension, the setup of the Schrödinger equation exhibits features one would expect from a

the quite similar thought presented in Squires (1988, 18)). This feature arises from the fact that in the EEC interpretation of the multiverse, consciousness is *associated* with the selection of alternatives, a different idea than ‘consciousness separating between alternative realities’ – the original Everett-DeWitt view. In EEC, consciousness, instead of passively residing with all possibilities given by the Schrödinger equation, gets an active role. According to Mensky, the question of free will can then be addressed as follows: “What is *free will*? ... all alternative behavior scenarios are present as superposition components but the subject can compare them with each other and increase the observation probabilities for the alternatives that seem more attractive to her” (Mensky 2007a, 403).

It is quite clear that the EEC interpretation of the multiverse is free will friendly since the individual is supposed to have an influence on what world of the infinite number of worlds to experience: Consciousness is not obliged to ‘stay’ with all parallel worlds. However, there are three issues with Mensky’s concept of free choices that require clarification:

- One issue is that Mensky only ‘allows’ the unconscious to have access to parallel realities (see, e.g., Mensky 2007b, 2010), a thought consistent with the fact that the best evidence for individuals getting knowledge of the future is physiological (hence unconscious) (Mossbridge et al. 2012); but how could consciousness then make any (free) choices if there is only one reality left to perceive? A potential solution would be that the number of parallel realities that consciousness considers is smaller than the number considered by the unconscious, but sometimes larger than one.³⁹ Conscious choices between alternatives – could subjectively be experienced in the form of phantasies or ‘case studies.’⁴⁰
- The other issue is that Mensky’s concept somehow equates perception with choice, a problem that will be addressed in the next chapter because sorting this

manmade theory. Certainly, people in different areas of the planet will all get support for the Schrödinger equation. But given the epistemological limits of mankind, the Schrödinger equation might rather be called *intersubjective* than objective.

39. ‘Sometimes’ is an appropriate description since in many cases choices are made by the unconscious leaving nothing left to decide for consciousness.

40. More precise than the English ‘case studies’ would be the German term ‘Probehandeln’ that had already been used by Sigmund Freud.

out is also relevant for the concept of densely and sparsely populated universes, i.e., the novel multiverse version that will be proposed, below.⁴¹

- Finally, a major problem of the EEC – not directly related to the free-will problem – that will turn out, however, to be quite relevant for the development to be pursued here pertains to the *solipsism*⁴² that Mensky's approach necessarily generates. This implies that EEC is ontologically problematic as will be demonstrated in the following.

Towards a free-will-friendly and ontologically convincing multiverse interpretation:

Different authors (Everett 1957; DeWitt 1970, 1971; Albert and Loewer 1988; Squires 1988, 1991; Mensky 2005, 2007a,b; Zeh 1970) have proposed different basic interpretations of the multiverse.⁴³ Each of those interpretations offers a different idea about how consciousness is *distributed* between parallel realities. Whereas the EEC concept is accommodating to free will, other existing interpretations are not.⁴⁴ The analyzed concepts are somewhat 'strange,' ontologically. Hence, a new multiverse interpretation will tentatively be sketched.

Everett-DeWitt interpretation: The original account by Everett-DeWitt simply postulates that consciousness is *separating* between different realities; those realities being the result of infinite branchings of the universe. This first theory of the multiverse has been criticized by Albert and Loewer (1988). They argue that this approach is incompatible with the conservation of mass problem.⁴⁵ Even more critical for the line of arguments presented here, this approach appears to open no room for free choices since branchings are assumed to be 'automatic,' and consciousness is assumed to follow all of them on equal footing.

EEC interpretation: We have seen that the *EEC interpretation is free will friendly* (Mensky 2005, 2007a,b). But EEC has a huge disadvantage, ontologically. To illustrate

41. In psychology, perception and choices are traditionally treated as separate processes (see, e.g., the textbooks by Hayes 1994; Lefton 1994).

42. According to the philosophical position of solipsism, a person can only be sure of her own existence. A nice overview is given by Fumerton (2006).

43. Further interesting interpretations of the multiverse that are, however, not useful in the course of my argument, can be found in Saunders et al. (2012).

44. This also applies to recent 'realist' interpretations of the multiverse that, from my point of view, do not allow for the existence of an actual free will (for an overview of such approaches see Saunders et al., 2012).

45. It is beyond the scope of this article to evaluate this criticism.

this, I am going to provide a simple choice example. For the sake of simplicity, I will not pay any attention to the blurred boundary between choice and perception at this point; this problem will be addressed in the next chapter. A couple, Tim and Louise, jointly decides whether to buy a Volkswagen or a Toyota as the sole family car. Louise wants a Volkswagen; however Tim wishes to buy a Toyota. Let me further suppose that *both* are *fully* successful in perceiving those realities they would like to see (Mensky 2005, 2007a,b, 2010, chapters 1 and 2). So Tim's consciousness realizes a Toyota, Louise's realizes a Volkswagen. This implies having to deal with *two parallel worlds* where in one of them, Louise is happy with Tim and the Volkswagen, whereas in the other, Tim enjoys his marriage with Louise and their Toyota. The problem with this 'wonderful world,' however, can be derived from Table 1 where the two individuals are listed in the rows, the two different realities in the columns.

		Alternative realities	
		<i>Reality 1: VW</i>	<i>Reality 2: Toyota</i>
Alternative individuals	<i>Louise</i>	Consciousness present	Consciousness absent
	<i>Tim</i>	Consciousness absent	Consciousness present

Table 1: EEC and the 'zombie' problem

The consequence is that there is no alternative reality where *both* individuals are present with their consciousness. From now on, each of the two partners lives with a 'zombie,' since consciousness is turned away crosswise from the respective realities of the spouses. In this example, free will would be rather unlimited, but would have an extremely high price, too: to basically live *alone*. This potential problem of some multiverse interpretations has already been detected by others. Barrett (1999, 186–192) calls it the 'mindless-hulk' problem, and although not crafted for the criticism of EEC (because Barrett's monograph preceded EEC) it fully applies to it.

I would like to again argue here in a teleological sense, by stating that living in a world of 'zombies' would intuitively not make much sense to me and would at least be perceived as quite unappealing or just 'strange' also by many other people. Although

there are well-known proponents of (moderate) *solipsism* such as Schopenhauer, stating that “THE world is my representation” (Schopenhauer [1818] 2010, 23), Kant, e.g., has argued against such a position, actually in form of sort of a teleology: “It still remains a scandal to philosophy and to the general human reason to be obliged to assume, as an article of mere belief, the existence of things external to ourselves ... and not to be able to oppose a satisfactory proof to anyone who may call it in question” (Kant [1781] 1996, B 39).⁴⁶

Universal consciousness interpretation: Squires (1988), when suggesting the same kind of ‘selection’ of one reality by the individual as Mensky (2005, 2007a,b), realized the solipsism problem and also argues in a teleological way: “... how do we ensure that different observers see the same result? ... I suppose I am here making the untestable (?) assumption that most people that I meet are conscious” (Squires 1988, 18). But then he makes a radical proposal that must be seen as an independent interpretation of the multiverse:

The only solution to this problem seems to be that “consciousness” has a unity, i.e., there is, in some sense, one consciousness which knows the result as soon as I ... have made an observation. This universal consciousness must then guide the selection of any subsequent observer. (*Ibid.*)

Requiring ‘one consciousness’ coordinating all individuals’ measurements on one consistent picture of the world (Squires 1988, 1991), however, is bringing back a singular reality ‘through the backdoor.’ Also, this view is *not* free will friendly, since the ‘one consciousness’ would have to kind of ‘dictate’ the individuals’ measurements/choices.

Many-minds interpretation: Albert and Loewer (1988) propose a ‘many-minds view,’ related to the earlier one by Zeh (1970).⁴⁷ This perspective is closer to the original Everett-DeWitt formulation than the perspectives suggested by Mensky and Squires; other than Everett-DeWitt, however, it explicitly brings in a probabilistic element. Albert and Loewer (1988) propose an infinite number of minds whose proportions of perceiving one or the other outcome of a measurement are assumed to resemble the probabilities

46. The following humorous statement by Karl Popper shows how difficult this discussion actually is: “I know that I have not created Bach’s music or Mozart’s...I just do not have it in me” (Popper [1956] 1999, 83). Although this consideration nicely demonstrates that Popper simply cannot be *alone*, it does not necessarily lend support to other visible entities possessing consciousness.

47. Differences between those authors’ and Zeh’s (1970) ‘many minds view’ will not be analyzed in this article.

of the “experimentally verified probability rule of quantum theory” (i.e., the Born (1926) rule; see also Squires 1991, 283, in an article comparing his and Albert and Loewers’ (1988) view). So if two outcomes of a measurement are, say, equally probable, half of the minds will see one of the two outcomes, and the other half will see the alternative outcome. The authors admit that “this talk of infinitely many minds sounds *crazy*” (Albert and Loewers 1988, 207);⁴⁸ Squires (1991) adds that he is not sure “... that the idea of an infinite number of existing minds ... makes ontological sense” (285). Since the probabilities are assumed to be given, Albert and Loewer’s interpretation is not free will friendly, either.

Densely and sparsely populated universes: So we are left with two equally problematic alternatives; the free-will-friendly EEC by Mensky, leading to solipsism, and all other interpretations not being free will friendly for different reasons. At the core of the problem is the question how consciousness is assumed to be *distributed* between alternative realities. All interpretations that have been proposed, so far, served the extremes: Consciousness is seen as residing with just one or all realities.

But what is the alternative? One possibility would be having densely and sparsely ‘populated’ universes in terms of the amount of consciousness allocated to them.⁴⁹ Let me introduce this concept by using the allegory of a torch light,⁵⁰ whose cone of light is brightest in the middle, and where the light intensity fades with more and more distance from the center. Let me assume that each individual’s consciousness is distributed in the same way as this cone of light. There is one reality where the center of consciousness resides, and there are neighboring realities where less consciousness resides. The ‘distance’ from the center is measured in terms of differing choices. Let us look at a situation where our individual in the middle of the cone of light (the one where the center of consciousness resides) decides to take a left turn at some traffic light using her car. In the multiverse, there will always be a ‘replica’ (a term used by Deutsch in many of his publications) taking the right turn. Now, the ‘replica’ taking the right turn is slightly off the center, with slightly reduced consciousness. The more the choices of a certain ‘replica’ differ from the choices of the ‘center individual,’ i.e., the larger the distance from it, the less bright the light of the cone, and consequently, the lower the amount

48. Sure enough, they developed this account for one purpose, only: to solve theoretical problems of the Everett-DeWitt formulation that they had earlier discussed in their article.

49. I am very grateful to Tanja Strohm for suggesting this solution to me in a discussion.

50. This allegory has the highest intuitive appeal with an old-fashioned torch light, since LED and laser have a more concentrated cone of light.

of consciousness allocated to this 'replica.' In other words, there is a smooth removing of consciousness from realities that are close to the 'center individual,' a strong removing of consciousness, however, from those that are located 'many decisions away.'⁵¹ Note that a similar allegory has been used in the philosophy of time: the 'moving spotlight.' "According to the moving spotlight theory of time, the property of being present moves from earlier times to later times, like a spotlight shone on spacetime by God" (Skow 2012, 223). However, although the 'moving spotlight' theory assumes the parallel existence of different times, there are important differences to the concept presented here. Here, not only times are parallel but also alternative realities at each point in time that are separated by decisions. Also, each individual (including her 'replicas') is using a separate torch light, whereas the moving spotlight is assumed to be 'universal' leading to an *absolute* past, presence, and future (Skow 2009, 2012). Finally, whereas an ideal spotlight has sharp boundaries and shines on just one time, the torch light in our allegory shines on many realities, albeit with diminishing intensity with higher distance from the center.

Given this reasoning, we may either find ourselves in rather densely populated universes, defined, say, as a cluster of 'similar realities,' where a lot of consciousness from many individuals resides (where many bright areas of the light cones meet); the condition being that many individuals have made decisions that get them into those 'similar reality clusters.' Or we are going to find ourselves in sparsely populated universes, where only few people have made choices leading them into our reality, and, consequently, where consciousness of others is involved to a smaller degree; and there might certainly be many cases where the situation is located somewhere in the middle between those two possibilities. However, since consciousness is only removed smoothly, there are no universes with actual 'zombies.' Or to stay within the allegory of the torch light, there is no darkness around the individual, even if only distant parts of the light cones of the other individuals/'replicas' reach that reality.

Although this novel interpretation clearly needs to be further elaborated in future contributions, I would like to argue that it is *free will friendly* because people have an influence on the reality to be experienced (with what degree of consciousness) and that it *makes more sense, ontologically*, than interpretations leading to either solipsism or to

51. Clearly, two questions are open to debate. First, it is unclear whether the 'center individual' will always be perfect in 'picking' the reality that is 'best' for her life or survival (and only the 'replicas' are characterized by less optimal choices). In fact, this might be very unlikely in case of, e.g., unresolved traumata or auto-destructive motives. Second, it is unclear whether only the 'center individual' has the power to make choices (and drags the others along), or whether each of the 'replicas' has some (perhaps small) influence on where the light cone moves (making the presented concept slightly more complicated).

consciousness splitting according to the Born rule etc. Following this novel interpretation, consciousness is *partially* decoupled from the physical world by being able to choose how much emphasis to put on what types of realities.

4. *Objective reduction and entanglement as an alternative to ‘save free will?’*

Quite recently, Hameroff (2012) also argued that Libet-type findings might be consistent with free will if consciousness were able to influence the actions of the brain/body as well as individual’s choices ‘backwards’; and, based on quantum brain biology, he is convinced that consciousness has this capability. However, there are two reasons why one might question that Hameroff’s theory, based on the *objective reduction modification* of quantum mechanics, is able to ‘save free will’:

1. *Reappearance of all paradoxes connected to time-backwards effects:* Hameroff’s argument that only ‘acausal’ information will be sent backwards (Hameroff 2012, 11) is hard to swallow. Either the respective information *changes something*, e.g., a choice, or it doesn’t, where in the latter case it is irrelevant, no? Only the *multiverse* interpretation of quantum mechanics is able to account for changes in the ‘past’ that are inspired by the ‘future’ and in turn change the ‘future’ (see Deutsch 1991). I simply do not see how any single-universe interpretation or the objective reduction formalism – both involving some sort of collapse of the wave function – would allow for this.
2. *The material world has to wait for all of us?* If one follows Hameroff’s theory regarding the fact that microtubules in the brain are able to maintain quantum states for a substantial time period (recent evidence appears to be in favor of this part of his theory; Science Daily, January 16th, 2014), how would free will play out outside the respective individuals’ brain in a singular universe? Does the outside world ‘wait’ for, say, one or two seconds for *each* individual’s brain to decide what reality to ‘select,’ and how would ‘bargaining’ between different brains take place if preferences are different?⁵²

52. Note that there is a similarity between this ‘bargaining requirement’ and the argument made by Squires (1988) in the framework of his multiverse interpretation: universal consciousness; that perspective has already been critically discussed above.

Those arguments show that Hameroff's (2012) way of demonstrating the possibility of free will in an objective reduction framework is implausible and hence no alternative to the respective claim based on the multiverse interpretation presented here.

How does free will act in the multiverse?

It turned out that free choices appear to be in principle possible if certain versions of the multiverse interpretation are adopted (either EEC with the unappealing consequence of solipsism or the densely and sparsely populated universes interpretation). So it might be tempting to ask how that works. Consciousness is associated with *perceiving* a specific outcome of the measurement process (see above). In psychology, perception and choices are traditionally treated as separate processes (see, e.g., the textbooks by Hayes 1994; Lefton 1994). So *how* could consciousness actually produce *free choices*?

One possibility of interpreting the action of consciousness is indeed that an individual's choices are *automatic*, given the perception that she has, and that free will works *indirectly*, via the ability of consciousness to influence what will actually be perceived. This is a complex thought, and an example will be used to clarify. It starts with a classical (non-quantum), decision-theoretic analysis: Julia wants to buy either a Volkswagen or a Toyota. If she perceives the Volkswagen as more reliable than the Toyota, she will buy it (unlike in the above example with Louise and Tim, there is no conflict between partners here; we may think of Julia being a single). If she perceives the Toyota as more reliable, she will buy that car. Thus, given her *preferences* (only reliability is relevant!) and her respective (automatic) *perception* of the reliability of the two cars her choice is fully determined. This simplified decision-theoretic analysis is depicted in Figure 2.⁵³ In this as well as in the subsequent Figures 3 and 4, the smiley represents the point where people think they decide.

53. For the sake of simplicity, the analysis is abstracting here from many complexities of those decisions, i.e., using heuristics, falling prey to biases etc. This picture is hence closer to a normative rather than descriptive decision-theoretic account.

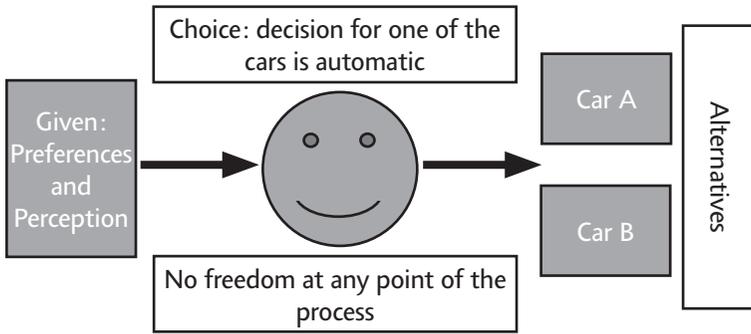


Figure 2: Free will in a simplified decision-theoretic framework

But let us now assume that her consciousness is able to *choose how she perceives* the reliability of those two cars simply by 'choosing' that alternative reality (more precisely, influencing the probability of subjective observation) in which one or the other car *is* more reliable.⁵⁴ Then, free will could play out in the *choice of the reliability perception* or more precisely, in enlarging the probability to observe this specific reality; given this operation, the choice of the car is still automatic (see Figure 3).

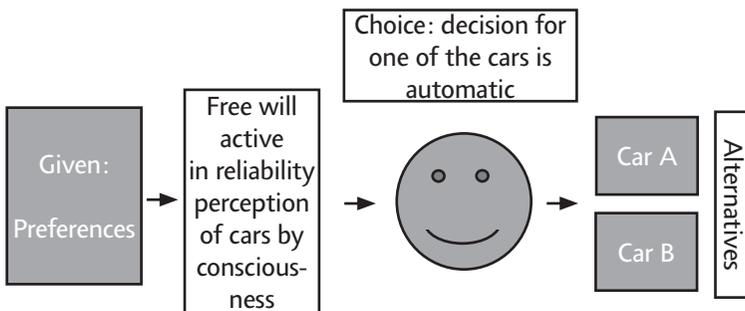


Figure 3: Free will when choosing how to perceive different realities

54. This idea (depicted in Figure 3) as well as the following idea (depicted in Figure 4) are somewhat inspired by Mensky's idea of postcorrection (Mensky 2007b). Specifically, the processes depicted in Figures 3 and 4 are two possible interpretations of the process of postcorrection, based on a more explicit differentiation between perception and choice than in Mensky's treatment.

Another possibility of thinking about this problem is that not a certain characteristic of an object is perceived (here, the reliability of a car), and a decision will automatically be made based on this perception, but instead the ‘attractiveness’ of different alternative realities already *including the choice* of a specific car (see Figure 4). Let us assume that parts of those possible realities are the different choices that Julia *has made*. So Julia can ‘opt’ between perceiving a reality in which she *has chosen* a Volkswagen and a reality where she *has chosen* a Toyota. If the reality with the Volkswagen turns out to be more attractive (still with the reliability of the car being the only component that differs), her consciousness may opt for perceiving this version as ‘real.’ It is important to note how consistent this description appears to be with what was discussed above as reinterpretation of the findings by Libet and coauthors: It was argued that consciousness might be able to work backwards. Indeed, this might be the way how choices are generally made. The interesting aspect here, however, is that our intuition as to what a choice is turns out to be somewhat violated; perception or *choices what to perceive*, might be sufficient: Everything might be about choices what reality to perceive!

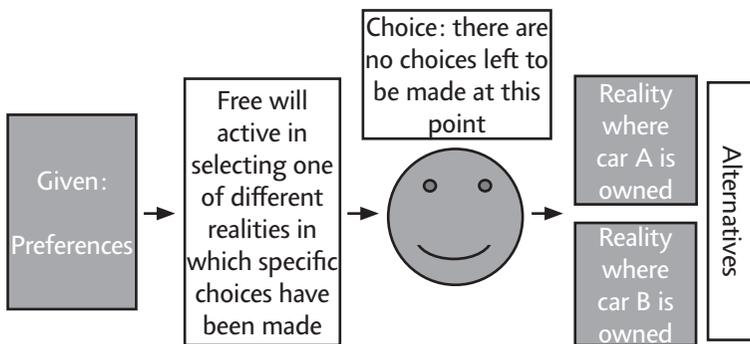


Figure 4: Free will when choosing in which reality to reside

Since the theoretical perspective depicted in Figure 4 appears to be the one that is most consistent with the reasoning presented in other parts of this paper, it makes sense to look at the consequences it might have on the sort of free will that the multiverse grants us with: It is a *freedom of perception*. We have the perceptual freedom to opt for experiencing certain realities rather than others. Moreover, this means that although consciousness is not supervenient on the physical, at the same time it has no influence on the physical (such a claim was earlier made and it should have become more transparent

at this point). But although consciousness has no influence on the physical, possibilities of perception are in principle infinite – even if the *degree* of flexibility in actually choosing between those ‘films’ is unclear at this point and might differ considerably between individuals and situations.

Conclusion and remarks

The results of the presented analysis are fourfold. First, it could be shown that the existence of free will critically depends on the existence of parallel realities; those multiple realities are characterized by the coexistence of different times as well as the coexistence of different, decision-dependent versions (i.e., ‘replicas’) of each individual (or perhaps better: parallel ‘worlds’). Second, since free will appears to be only possible in the multiverse, a teleological argument claiming that qualia should have a purpose and that free will should be that purpose leads in turn to a preference for the multiverse interpretation over other interpretations of quantum mechanics. Third, the paper proposes a novel form of the multiverse interpretation that is not only free will friendly but might also be seen as ontologically acceptable. Fourth, the paper analyzes how free choices might be made in the multiverse and arrives at the conclusion that free will is about choices what reality to perceive.

To craft the ‘presumptive evidence proof,’ this contribution had to deal with theories and empirical findings from quite a few different areas, and it is beyond my expertise in many of those areas to formulate precise future research opportunities. Indeed, readers who are experts in the respective areas will certainly find it much easier to develop such ideas. Therefore I am taking the liberty, here, to develop a rather personal perspective by asking the question what I would like to work on next, what I perceive as exciting paths for future research, and to select two questions that I feel are of most interest to the readers of this journal.

As a researcher originating from the decision sciences, the first thing that comes into my mind is the large impact that the thoughts presented in this paper might have on the decision sciences as well as game theory. Very recent research labelled “quantum social science” (Haven and Khrennikov 2013) has already taken the route of linking quantum mechanics and questions in the decision sciences, but in a way radically different from what would result from the analysis presented in this paper. Specifically, the analysis by Haven and Khrennikov (2013) avoids the multiverse interpretation of quantum mechanics and just applies the quantum formalism to human decision making whilst also avoiding to answer the question why it should be relevant to it:

We emphasize that in our approach, the quantum-like behavior of human beings is not a consequence of quantum-physical processes in the brain. Our premise is that information processing by complex social systems can be described by the mathematical apparatus of quantum mechanics. (Haven and Khrennikov 2013, xviii)

Whereas the analysis presented in this paper would require also linking the 'content,' a deeper understanding of the multiverse interpretation of quantum mechanics to the actions of consciousness in selecting between alternative realities. It would be most appropriate to collaborate on this matter with a quantum physicist open for (or convinced of) the multiverse interpretation of quantum mechanics as well as open for its application to human decision making.

Another interesting route to be taken might be the analysis of the consequences of the presented approach to philosophy in general, over and above the free-will question. For instance, does the multiverse interpretation of quantum mechanics offer a novel scientific underpinning for philosophical idealism? Would the multiverse view fit best with the early Hindu/Vedanta version of idealism, or would it rather fit with Neo-Platonism, with the philosophies by Spinoza or Hegel, or with German idealism? Here, collaboration with a philosopher knowledgeable in different idealistic philosophy traditions would be most suitable.

Finally, what are the consequences of the multiverse view on how we see and live our lives? The most dramatic shift when moving towards a multiverse view might be the resulting understanding of the plethora of possibilities how to experience our life since free will, most probably in the version of a freedom of perceived choice, can be justified within this framework. Even though the exact flexibility we would have for perceiving different realities is unclear and most certainly dependent of the individual and her circumstances, this might, in turn, leave not much space for people feeling as 'victims of circumstances.' Rather, it should strengthen the perception of responsibility. And people who understand having an actual influence on what they experience in their lives might also act differently, less fearful, perhaps, and more optimistic.

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