On the best available evidence for the Survival of Human Consciousness after Permanent Bodily Death

by Jan Pilotti

A month ago, I met my old friend Leonardo.
Leonardo: Hi Jan. I heard you are writing an essay on life after death. I was a little surprised that you as both a physicist and physician are interested in religious beliefs.
Jan: Hi Leonardo. I understand your question. Most religions and ancient wisdom teachings have a belief in life after death, but this essay will look upon what can be known from the perspective of modern science.
L: You are kidding. Of course, you know that there can be no life after death as the body disintegrates.
J: Well, but there are some religious beliefs that God will recreate whole our physical bodies. And if you believe in an omnipotent God this is a consistent belief. But, of course, outside what we can study scientifically. But as is said in the essay title we will discuss evidence for that *consciousness* can survive permanent bodily death.
L: But it's just as bad. When the body is permanently dead the brain also disintegrates, and as consciousness is created by brain there can be no consciousness without a brain.
J: Are you sure that there can be no consciousness without a brain?
L: Yes, and if you talk about science you must know that science has proven that consciousness is a product of the brain.
J: Yes of course I know that this is what is said, and that many believe so, even most scientists. I myself when I started my academic studies in mathematics and theoretical physics was convinced that the materialistic world view, that we are just our bodies and brains, was self-evident. And all talk about spirits and life after death was what Karl Marx called "the people's opium". But I had to change my mind, first through a discovery when I studied Einstein's theory of relativity. Though Einstein said that nothing can go faster than light it is possible to describe phenomena with velocities higher than that of light in higher dimensions. And then when I changed to medical studies and read about near-death-experiences (NDE).
L: But NDE is just hallucinations due to lack of oxygen in a dying brain. And what have higher dimensions to do with life after death?
J: Let me come back to higher dimensions and consciousness later. But first I am honestly interested to know why you believe that brain produces consciousness.
L: It is not a belief it is scientifically proven.
J: Ok, what do you think science has proven about consciousness and the brain?
L: Almost every week there are articles or TV programs about how brain researchers have found where different conscious functions are located in the brain. And you can read about that in any book about the brain.
J: Of course, I know that. And if it were so that consciousness can exist only as a product of the brain, it would be futile to look for scientific evidence for consciousness after bodily death. So, it is first necessary to look in detail at what brain research has actually shown. And I honestly want that we do that together. Ok?
L: Ok.
J: It is often said that it is difficult to *define* consciousness. But I think this, at least partly, actually is due to that we can't *explain* consciousness, and as a way to disguise that. And it is said that consciousness is the last big question for science, even a mystery. I give you some references for that later. But let me now for our dialogue give a simple description or definition of our ordinary consciousness, or perhaps better called the content of consciousness:

Sensory experiences: sight, hearing, taste, smell, touch etc.
Mental experiences: memories, thoughts, dreams, fantasies, hallucinations, etc.
Emotions: sadness, joy, etc.
These we know what they are through direct experiences. Of course, a big question is "who is the I who have the experience", and also, if it is so, "who is the I who survives". But let us leave these questions for the moment, so we get to a start.
L: Fair enough, but we must come back to that.
J: Yes. But why do so many, even scientists, believe that the brain produces consciousness and that the brain is necessary for all possible conscious experiences?
L: First, we always have the brain with us when we have conscious experiences.
J: Actually, we never experience our brain. And e.g. there are no pain receptors in the brain, so we can operate on the brain in patients who are awake, only with local anesthesia of the skull. But we can say, we experience the head and we know that the brain is in it. But only when we are awake. But what about dreams and even more NDE and out-of-the body experiences OBE? I come back to that too.
L: Ok. But very clearly, affecting our brain through our sensory organs affects our experiences: e.g. touching our bodies and closing or opening our eyes. And alcohol and drugs affect our brain and consciousness. And injuries on the brain affects both sensory and motor functions. And, as you well know, we have an enormous amount of research showing what happens in the brain when persons have different experiences, through all modern techniques, as fMRI, PET scan etc., which can measure brain activity in living awake persons.

Correlations are no proof

J: Yes, what you point to are correlations between what can be measured in the brain and different experiences. But I think it is important what I learnt in a very elementary course in statistics in my medical studies, but many seem to forget: if A and B correlate it can be A causing B, or B causing A or even C causing both A and B, but not direct causality between A and B. So, the correlations between the brain and experiences does not prove that brain produce consciousness. And, which is also often forgotten, the correlations are nor any explanation of how brain can produce consciousness. Even those who are convinced that consciousness is created by brain admit that correlations are not enough. E.g. Guilio Tononi's IIT (Integrated Information Theory), describes consciousness as information in mathematical terms. He and Christof Koch presented the IIT 2014 at TSC (Towards a Science of Consciousness conference), and pointed out, that despite all the great advances, with modern imaging methods of living brains, which focus on correlations between conscious experiences and brain processes, it is not sufficient as an explanation. It can e.g. not even explain why the cerebral cortex can (according to GT and KC) generate consciousness while the cerebellum, which has more brain cells and seems at least as complex, does not [1].
L: When I listen to you, it sounds logical. But is it not too simple? Can it be correct? Why is this then not expressed more by other brain scientists?
J: A very good question, but beyond what is the focus of what I am writing now. But I think it concerns how science changes, in what Thomas Kuhn called paradigm shift [2].
It ought to be quite clear if we look at correlations from an analogue with a TV-set. If I change program with my remote control of course there are correlations between what happens in the remote control and in the TV-set and the picture I see on the TV screen. A Neanderthal with a Voltmeter and an Amperemeter could get a huge number of exact correlations between the voltages and currents in the TV-set and the picture on the screen and could have formulated a good scientific hypothesis that the picture on the screen is created in the TV-set. But we now know better. Without TV waves, that is the broadcasted

electromagnetic waves coming from the studio in the space outside the TV-set, there will be no program at all just "snow" or "war of the ants" on the screen.
So correlations between voltages and currents in the TV set and the picture does not prove that the TV set is sufficient to produce the picture. It actually does not even prove that a (specific) TV-set is necessary to see the program. Because if the TV-set is broken, partly or totally we can choose another TV-set or even go to the studio and see the program live.
And due to all new techniques to measure on a living brain (fMRI, PET scan etc.) we have, as you said, a huge amount of correlations between experiences and brain process. But the example with the TV-set shows that it is a faulty logic that correlation proves cause. It proves neither sufficiency nor even absolute necessity. So, in spite of all correlations between brain processes and conscious experiences this cannot prove that consciousness is created in or even by the brain. It cannot prove that the brain is sufficient for conscious experiences and actually not even prove that the brain is absolutely necessary for conscious experiences.

L: I see what you mean. But as you say yourself, now we know about TV-waves beyond the TV-set. But there is nothing we know that exists beyond the brain than the physical world, so this analogy does not support anything beyond the physical world and thus nothing after death.
J: You are right. The analogy is just to show how easy it is to draw wrong conclusions from correlations. But what this essay shall focus on is evidence that there actually are more in our world than the brain and the physical world.
L: Well, I doubt that that is possible, but I am eager to hear what you have to say.
J: I appreciate your openness. So, let us look at

What can a brain *really* do?

At the start 1994 of Towards a Science of consciousness (TSC), the greatest ongoing yearly international multidisciplinary conference, gathering all leading researchers on consciousness, the young unknown philosopher David Chalmers became famous over a night by differentiating between the easy problems and the hard problem. The easy problems mainly concern behaviour and cognitive function, which can be explained by the brain. (Well not quite: e.g. we know what (muscular) effect an electrical impulse in the brain will have but we don't know how our will can start such an impulse). The hard problem concerns our conscious experiences such as the audial experience of a clarinet or the visual experience of a red apple [3]. Of course, we know the physics e.g. of light reflected from the red apple and how it create an upside down image of the apple on the retina and how the light energy changes chemicals in the cells in the retina and then, through processes in the brain, reaches the visual cortex, as a complex electrochemical signal, at the back in the brain. And? What happens there? Even brain researchers who believed (Francis Crick, who has left this life) and still believe (Christof Koch) that the brain produces conscious experience have to admit, no one has a clue:

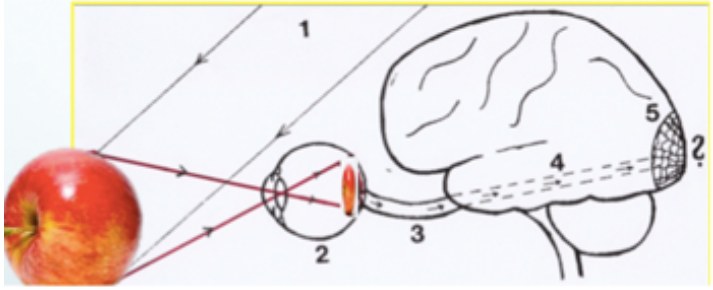

Figure 1

"No one has produced any plausible explanation as to how the experience of the redness of red could arise from the action of the brain." [4].

Alva Noë, professor in philosophy at Berkeley Institute for Cognitive and Brain Sciences, writes:
“It would be astonishing to learn that you are not your brain. All the more so to be told that the brain is not the thing inside you that makes you conscious because, in fact, there is no thing inside you that makes you conscious.” [5].

David Chalmers, now professor in philosophy, writes:
”There is nothing that we know more intimately than conscious experiences. But there is nothing that is harder to explain.” [6].

Antti Revonsuo, professor in psychology and cognitive science, put it even stronger:
“Why is consciousness considered a 'mystery'? After all we know consciousness intimately from the inside, it is the most natural thing there is for us and it is ever present in our lives. Of course, in that sense there is no mystery at all about consciousness. In fact, there is nothing in the world that we would be acquainted with better than the subjective experience vividly present for us all the time. The problem, the absolute mystery, is elsewhere: *we do not know how to fit consciousness together with the world-view of science" (*my italics). [7] .

"The basic nature of the mind - the stuff from which our conscious mental life is created - is still a mystery to science." [8].

How can it be that science, which has been so successful in so many areas, still has nothing to say about the explanation of our conscious experiences? Or is it that mainstream science has made some great mistake?
L: With so much research and researchers, how can they possibly go wrong?
J: Well, not any of our normal daily experiences can be explained with the brain. Therefor no one can claim they have an explanation of consciousness. That consciousness is produced by the brain is just a hypothesis. And therefore, we don’t know that the brain is creating even our ordinary consciousness. We cannot exclude that consciousness can exist without a brain, and thus even possibly exist after the body and brain has disintegrated. So, science cannot exclude that consciousness exists after death.
L: Ok, but that does not prove that life after death exist. You have certainly heard about Russel’s pink teapot. We cannot exclude that there is a very small pink teapot orbiting Saturn. But that of course does not prove that this pink teapot exists.
J: Yes, we cannot falsify that there is a small pink teapot circling around Saturnus. So non-falsifiability does not necessarily mean it exists or not even that it is plausible. But here is a great difference: no one claims having any experience whatsoever related to a pink teapot around Saturn. But there are experiences which seemingly indicate survival of consciousness and which many people accept as evidence.
L: I admit that this could be an important difference and that one can theoretically speculate about consciousness after death. But theories by themselves cannot prove what exists or not exists, they can only make predictions, based upon some presupposed not proven axioms. So, there must also be empirical verifications. So, are there really any experience which indicates that consciousness survives?
J: Yes. For example, communication, directly or via a psychic medium, with an alleged dead person which is recognizable as a person who have lived before and who can give relevant information. Or a young child talking about how she lived at another place with another name and gives the names of the family members she lived with, which turns out to be correct and she recognize them. If we take these experiences at face value, they certainly support life after death.

L: But this is just stories and there must exist better explanations without belief in life after death. And I think they can't be taken seriously by science.
J: Very god comment. Many if not most mainstream scientists reject these experiences and all parapsychological experiences. But I claim, not for scientific reasons, but from a closed dogmatic position. Just two examples: When Etzel Cardeña, professor in psychology at Center for Research on Consciousness and Anomalous Psychology, in Lund, Sweden, wrote a review article [9] about parapsychology in the prestigious mainstream *American Psychologist* showing robust statistical results, two psychologists answered in the same journal: we don't look at data, we know that these phenomena cannot exist.[10]. They also claimed support from modern physics, where they were totally wrong [11]. But to not look at the data is not science but dogmatism. And Jessica Utts, professor emerita in statistics, writes: "The data in support of precognition and possibly other related phenomena are quite strong statistically, and would be widely accepted if they pertained to something more mundane." [12].
And so, there is very little economic support for academic research in this era. But fortunately, evidence for life after death are taken seriously by some scientifically openminded researchers. I will here just mention the very thorough analysis by the professor emeritus in philosophy Stephen E. Braude in his book *Immortal remains*. *The evidence for Life after death* [13]. He looks at different mediumistic phenomena, reincarnation memories, out-of the body experiences and near-death experiences and surveys much of the research. To really see why the best cases of mediumistic communication or reincarnation probably need some extra-ordinary explanation one must read the long case stories and Braude's very sharp analysis, and I will lend you Braude's book when I have finished my essay. So here I just shortly summaries Braude's results and then I will focus on NDE. So, first

Braude's analysis of mediumistic and reincarnation cases

As a tool in his analyses Braude first states that there are data showing that parapsychological phenomena exist: telepathy, clairvoyance and precognition[1], together named extra-sensory perception, ESP. And together with psychokinesis, to affect matter at distant with the mind., called psi. He is open for survival as explanation for mediumistic information and also that reincarnation suggests survival. But he also looks in detail at other interpretations or possible explanations.
First, he discusses what he calls *The Usual Suspects*: misreporting, hidden memories, malobservation or fraud.
L. Yes, that's what I think. I have heard there are many examples of fraud.
J Yes, there are some. Science is a social enterprise conducted by persons with all human virtues and vices. And as you know there is unfortunately also fraud in many sciences, as e.g. cancer research. So, the possibility and example of fraud cannot be taken as a proof that the phenomena cannot exist. And you cannot claim fraud due to that the phenomena are impossible which is not proven.
L: Ok.
J: "And in fact", Braude states, "proponents of the survival hypothesis (hereafter survivalists) have been reasonably successful in deflecting these sorts of counter-explanations. That's undoubtedly one reason for the continued interest in the topic of postmortem survival." [14].

Then he looks at *The Unusual suspects.* E.g. when a person shows a new skill, speak a langue not learnt by normal means, Braude argues that this is very like what seems to happen in dissociation and multiple personality.

[1] The phenomena of retrocognition are also studied in parapsychology.

But he also argues that there are some good cases which strongly indicate some paranormal process. And here he sees two competing explanations: survival or psychic functioning among the living. The latter is " … often called 'super-psi' explanations because they apparently require more refined and extensive psychic functioning than we discover in controlled laboratory studies."[15]. For example, a medium can get information from attending people by telepathy, and information about a hidden treasure by clairvoyance. But Braude also argues that we have no ground to put a limit to psi.
For many good cases Braude concludes that it is difficult to choose between survival and super-psi as the best explanation. I agree as the survival hypothesis can never be refuted as one can never prove non-existence for logical reason. Also, super-psi can never be refuted or, as Braude using Popper's term, falsified. Popper argued strongly that a hypothesis must be possible to falsify, to test with a negative result, in order to be counted as science [16].
Braude here differentiate between strong and weak unfalsifiability:
"Hypothesis H is strongly unfalsifiable: nothing whatsoever can count against H.
Hypothesis H is weakly unfalsifiable: (a) both H and not-H are compatible with the data, but (b) some evidence can reasonable taken as rendering H less plausible than not-H." [17].
Braude then argues that super psi hypothesis is unfalsifiable only in weak sense.
And he argues that "crippling complexity" tips the scale to prefer survival hypothesis as explanation: A super psi explanation needs many sources to get all the information but if contact with a survived spirit there is needed only one source or causal link, and therefore more stable against hindrance to that part of psi which is also needed in communication with survived entities [18].

And he ends with:
"And I think we can say with, little assurance but with some justification, that the evidence provides a reasonable basis for believing in personal postmortem survival. It doesn't clearly support the belief that everyone survives death; it more clearly supports the belief that some do. And it doesn't support the belief that we survive eternally; at best it justifies the belief that some individuals survive for a limited time." [19].

L: A possibly correct philosophical conclusion, but I must say of limited comfort for the hope of eternal life. And not democratic.
J: I am glad you think so. I agree. And probably Broad too, because he adds:

"Obviously this leaves plenty of room for further research and speculation. … And of course, we haven't considered fully how to frame a metaphysics that adequately accommodates for survival. We might need to adopt something like a Cartesian dualism. Or … adopt a kind of Whiteheadean or process metaphysics." [20].

L: What is that?
J: Whitehead I am not so knowledgeable about. But Cartesian dualism is about that matter has extension in space, res extensa, but mind, res cogitans, has no extension in space. And in this context the question of the existence of a mind or better soul which can exist beyond body and brain.
L: But that the mind leaves the body is what many thinks happens in near-death experiences you mentioned. I have read some articles about that.
J: Yes. And also Braude writes much about NDE and out-of the body experiences. But he concludes that "… the case for survival receives very little *independent* support form OBEs, NDEs and apparitions. … Of course, we might find an externalist view of OBEs and apparitions more attractive in light of evidence from mediumship and reincarnation. And we

might decide that OBEs and apparitions strengthen the case for survival made by the better evidence." [21]. In short Braude argues that OBEs and NDEs can be explained by known phenomena and super-psi.
But I have another view on that, perhaps due to my coming not from philosophy but from physics. And I think that NDE support that consciousness can exist beyond brain and so give more support for survival.
L: That sounds strange. How can physics indicate another interpretation of NDE? But if so, it is also interesting.
J: Thanks. The mediumistic cases were not so many, especially not the good cases, and seem to have decreased in the second half of 20th century, at least in research. Reincarnation cases also are not so many but seem to still come around. But NDE are counted in thousands and are actual today so we have much more reliable witnesses and data and possibilities for scientific studies.

Near-death experiences

And as you probably already know it is now well established also by prospective studies that people who have been physically close to death and who yet survived, can sometimes tell how they felt as if they had left their body, floated above and "seeing" their body from above and could "see" what happened around their body and even far away, which also sometimes seems to have been correct, which is the OBE-part of NDE. And some also experience a "different world" where they met dead relatives and a being of light. For most people who have had an NDE, it changes their view of life and they believe or are convinced of an afterlife and see a deeper meaning also with this life before death as growing in knowledge and love [22].
L: Of course, this is a valuable insight in the meaning of life, but unfortunately based on illusions. When the heart stops there comes no oxygen to the brain and so all this is hallucinations in a malfunctioning dying brain.
J: Well, that is again what many scientists believe and say. But actually, not a well-grounded speculation and even less an explanation. The OBE part has also been experienced in a wide variety of situations even when the body is active and awake, so arguably not any lack of oxygen. I met a teacher who told me that her car skidded when she drove in the winter. She then felt as if she was thinly spread out under the roof of the car and from there she saw how her physical body correctly acted to correct the skid.
L: Ok, if so, but there must be other changes which can give brain malfunction and hallucinations in a dying brain.
J: I agree with you that of course it happens something in the brain at the start of an OBE or even more in NDE. But only in the sense that it happens something in the TV-set when we change channel. And this is again only correlations and triggering the experiences. But no explanation how the experience is created. You say the brain creates hallucinations. But how? As we have seen no one can explain even a simple ordinary sensory experience with the brain, so it seems quite a speculation to just say that the brain produces these complex experiences as "hallucinations".
L: Hm, if you put it so, ok. But you can't prove that it is not a hallucination created by the brain.
J: But we can. There are people who after an NDE could tell what happened not only around their body but in places at distance and not possible to have any normal sensory experience of. And in some cases what they saw and heard was verified as correct, so called veridical cases. This cannot just be hallucinations, as a hallucination is thought to be created by the brain without any correspondence in reality. Anita Moorjani had an NDE, which I will come

back to more later, where she saw what happened around her physical body and also at short and long distance from her physical body. She writes:

NDE example 1.
"I began to feel weightless and to become aware that I was able to be anywhere at any time … I didn't even think it odd that I was aware of my husband and the doctor speaking to each other outside the ICU, some 40 feet down a hallway" and
"Simultaneously …. I became aware that my brother, Anoop, was thousands of miles away on an airplane, anxiously coming to see me." [23]
This have the same structure of many NDE which are corroborated, even if Moorjani does not here focus on that.[24]

NDE example 2.
More corroboration is in the episode told by professor in psychiatry Bruce Greyson [25], which was his first encounter 50 years ago with what Moody later called NDE. Greyson sat eating spaghetti and tomato sauce, when he was called to an emergency psychiatric patient who had tried to commit suicide. He had at the call got a blob of tomato sauce on his tie, but he was in hurry, so he didn't go to the room where he had other clothes. He saw the girl, Holly, who was unconscious, that is didn't respond to any stimuli and had closed eyes. Then Greyson went to a lounge at the far end of the hallway to talk to Holly's friend trying to understand why Holly had tried to kill herself. Then he went back, and Holly was still unconscious and had been so all the time according to the sitter who watched Holly. Next morning, Greyson went to Holly who was awake but a little drowsy. When dr. Greyson presented himself, Holly said she recognized him.
"You looked like you were asleep in the ER last night. I didn't think you could see me."
'Not here but over there when you talked to my friend.' And Holly told correctly in detail about their talk and also how he had moved a fan. She also said she had seen the tomato spot on his tie.
Greyson had never heard anything like that and was astonished how it could happen but could not deny that what Holly said was correct.
Greyson is a pioneer in NDE research and perhaps now freer as emeritus professor, but he is a respected psychiatrist and scientist, and I think he would not risk his reputation so there is no reason to doubt what professor Greyson tells us.
L: Ok, sounds fair enough. But just one or two cases?
J: No, and dr. Greyson also refers [26] to a study by counseling professor Janice Holden [27]. She had reviewed 93 reports of out-of-body perceptions during NDEs. She found that 92 percent were completely accurate describing what happened around them, 6 percent contained some error and only 1 percent completely erroneous. But she also points out that all cases were anecdotical, so can afterwards not be more examined in detail what happened and is thus weaker concerning studying possible natural explanations than prospective studies. Holden also reviewed five prospective studies where one in advance decide to interview persons in a defined group, e.g. all those who come to a hospital with cardiac arrest, which are stronger as one can examine more in detail around the time it happens. No veridical case has been found in these five prospective studies. [28].
L: Well, veridical cases if true are very challenging. But, as we have talked about super psi, this must be a possible explanation of all veridical experiences.
J: Yes, if you accept psi, which most scientists doesn't. And I suppose that you think psi then can be explained by brain function.
L: Of course, what else?

J: But then we are back to that, the hypothesis that consciousness is produced by the brain, which I call brainmaterialism, can never be falsified in strong sense, as for even a good veridical case in a prospective study you can always say: Strange but must be something in the brain which also have some psi functions.
L: Well so it seems. So, then the question is not decidable scientifically?
J: Close to. But there are stronger cases with veridical information where the brain is even "shut down". After 10-20 seconds when the heart stops there is no blood flow to the brain. "Research in both humans and animals has shown that during induced cardiac arrest the loss of function of both the cerebral cortex and the brain stem results in unconsciousness within seconds. All brainstem reflexes are gone too: … The respiratory center, near the brain stem has also stopped functioning, as evidenced by the suspension of breathing. … and in animals also electrical activity of the deeper structures of the brain have been measured. … after a very short time the electrical activity in the cerebral cortex and in the deeper structures disappears completely. … the complete loss of all electrical activity in the cerebral cortex *always* results in a *flat EEG*, after ten to twenty seconds." [29].
L: Wow, it really seems that the brain is shut down. But are there any cases with NDE were this shut down is monitored?
J: First, which is van Lommel's argument, all persons with cardiac arrest will have this brain shut down after some seconds, and there are many cases with cardiac arrest and NDE. Even some veridical cases. [30].

NDE example 3.
A very famous case often discussed in NDE-literature and made film of is Pam Reynold's NDE.[31].
For a life-threatening aneurysm (hernia of an artery) in the brain she went through an operation with hypothermic cardiac arrest. Her body was cooled down, her heart was stopped and the brain was emptied from blood by tilting the body. She had ear plugs emitting high sound, which made possible to measure brainstem activity (where all vital functions are controlled), but no possibility to hear what happen around her. In short, she had and NDE with an OBE and she heard and saw what happened when her body was cooled to 60° F, cardiac arrest and the brain was empty from blood and no brainstem signals at all. And flat EEG. So, it can be said she had an NDE and veridical OBE although measurable brain activity of the specific form regarded by contemporary neuroscience as the necessary condition of conscious experience was gone.
L: Oh, that seems more difficult to explain. But as the person is not dead, there must be activity going on in the cells.
J: Yes, you are right. Already Moody wrote: "Even in those cases in which the heart was not beating for extended periods, the tissues of the body, particularly the brain, must somehow have been perfused (supplied with oxygen and nourishment) most of the time. … In order for resuscitation to have occurred, some degree of residual biological activity must have been going on in the cells of the body, even though the overt signs of these processes were not clinically detectable by the methods employed." [32].
But it can then be argued "The issue is not, however, whether there is *any* brain activity, but whether there is the type of brain activity that is considered necessary for conscious experience. Such activity *is* detectable by EEG, and it is abolished both by anesthesia and by cardiac arrest." [33].
But if we are honest, as science should be, when we argue that we don't know how brain can produce consciousness, only that we know about correlates, we must be open to that consciousness can be created in another way than considered today, and if you so believe in a more subtle way inside the cells in the brain. And that only for normal experiences we have

the correlations to “the type of brain activity that is considered necessary for conscious experience”. But in these extra ordinary cases this must not be the case. We who believe consciousness can exist without brain must also trust on new processes, not in brain, but beyond brain. So again, two hypotheses which are seemingly strongly unfalsifiable, that is none can be definitely ruled out. But I think the brain hypothesis is at least weakly falsifiable or even strongly falsifiable, as it has problem to or can’t explain all aspects of NDE, and I come back to that. But as you correctly said veridicality can be explained with super-psi. And even these cases with more or less brain shut down can be explained, if one so wishes, with that the experience is created by the brain at a later moment, when the brain function is more normal, invoking retrocognition.
L: So, we still cannot decide what is the best explanation? We got stuck there.
J Well, at least it is not so easy. But I think we can come a little bit further.
L: If we can come further it sounds interesting.

J: Yes. I think, as we have no idea about how a brain can produce any experience at all, we are fully entitled to take NDE and OBE at face value, and instead of trying to explain them away with some yet unknown brain function, perhaps NDE and OBE can teach us something new and important about consciousness. And as no one has explained even any ordinary sensory experience with the brain let us look at it from scratch. Galileo Galilei strongly influenced the modern scientific method in17th century, with a worldview where the objects in the world have shape, size and movement but no “sensory qualities”, such as color, tones, taste, smell, which are then seen as subjective additions to the objective material world and that these "exist" or "are created" in some unknown way in our brains. Descartes advocated a dualism in which the objective matter, with extent in space, was different from the mental which lacked extent in space, but that these could still interact via the pineal gland. With this strong background or bias in science there is a great resistance to let go of the dogma that consciousness exists in the brain. But I think the situation in consciousness research is much like that in physics in end of 19th century, when we had a huge amount of spectroscopic data and even exact mathematical formulas for them but no theory and could not even explain the stability of the atom, the basis of matter, before quantum theory and Einstein’s theory of relativity gave a radically new understanding of matter and space and time. We need an equal radical change in our conceptualization of brain and consciousness, and I think this change is on its way. As in physics it must be based on observations and experiments, and there are observations we all can do without any expensive apparatus. So

Let’s see for ourselves

Exercise 1.

J: Here I give you an article in your hand. When you read from this article, where is the article located?
L: What do you mean? It is here, I mean there - I hold the article in my hand.
J: Good, so you agree that the article is some decimeters in front of your nose.
L: Of course.

J: Please close your eyes and forget everything you have heard about this. Take a deep breath open your eyes and answer the question: "Where is your visual experience of the article located?" Take time to look.[2]
L: What do you mean? In my brain, of course.
J: But how can you know there is an article in front of your nose.
L: I feel it in my hand.
J: Ok. But where is the feeling located?
L: In my brain?
J: Well, but if in reality you were chased by a tiger where is the tiger you see running towards you located?
L: I see what you mean. How can I know that there is anything outside my brain?
But for all what I have heard we see with our brain.
J: Yes, so it is said. But Georg von Békésy, physicist and Nobel laurate in physiology, writes "*Projection of a sensation outside the body.* The funneling of sensations into space outside the body is an important feature of neural funneling, for it controls practically all our behaviour. For example, reflected light from an external object produces an image in the retina. The sensations exist only within our body, yet we localize the image outside the eye, even when we use only a single eye and look at an object far away. This localization beyond our perceptual system is of great importance for survival because it enables us to appreciate impending danger or objects of great necessity. This externalization is achieved without the slightest recognition of the optic image itself or the stimulation on the retina. ... This external projection has probably been learned early in life; certainly this is true for hearing and vision." [34].

J: Of course, a survival value! If all that we can eat, all who we can mate with and the dangerous tiger, which we must flee from, are pictures in the small space where our brain is it would be chaos and we would not survive very long. But *how* learnt?
The neurophysiologist Benjamin Libet wrote that "Subjective localization of a sensory stimulus (visual images) in space...still mysterious..." [35].
L: A bit confusing though. Von Békésy first says that sensations exist only within our body, but both von Békésy and Libet say our sensory experiences are projected, subjectively located out in space.
J: Yes. I think they mean there are something in the body or brain which von Bekesy calls "sensations", which is confusing as we don't have any experience in brain at all. But they agree on projection. So where do you actually locate your visual experience?
L: Well, I see the article in my hand, but was afraid to say that as I know it is said I see with my brain.
J: Good. Yes, it takes courage to trust one's senses when most scientists say it is in the brain. And Libet says this projection or subjective localization in space is a mystery. But is it really

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[2] The exercise for a reader of this essay: You are reading on a screen/paper. Where is the screen/paper located? I think you will agree that the screen/paper is some decimeters in front of your nose. Please close your eyes and forget everything you have heard about this and when after taking a deep breath open your eyes and answer your question: "Where is my visual experience of the screen/paper located?" Take time to look. If you say, "in my brain or in my eyes", I must ask you how you then know that there is a screen/paper out there in front of your nose?

so mysterious? And is it really a projection?
I have never ever had any sensory experience that has been located in the little part of the space where my brain is located. All my sensory experiences are outside the brain. I have sensations in my body, smell in nose, taste in mouth, I can feel touch on my body, I can see my body but most what I see is outside my body even far away from my brain. And so even what I hear. This is the best example I know of about *The Emperor's New Clothes*. I am not an alien. I am convinced every one of us has their sensory experiences outside the brain. But few speak about it as we have learnt that it must be in the brain
L: This sounds possible but very strange as I have never heard it before. But I must admit it fits better with my own experiences too.
J: I am glad to hear that. When I first wrote about this it came as an Aha! moment when I tried to understand if NDE was hallucinations or not. But since then I have "trained" to stick to that my sensory experiences are outside my brain, so now I can't see or experience it in another way.

I wrote in a Swedish book 1987 [36] (here my translation)
"I mean that dualists are absolutely right when they claim that the mental is not a brain process, but the materialists are also right, at least when they claim that sensory experiences are identical with matter. But not with matter in the brain, but I want to say that visual experiences, of an object/ e.g. of this book, are most easily interpreted as identical with the real matter, the book, out there in the space outside our brain and body. The French philosopher Henri Bergson [37] has also argued extensively for this. We do not need the hypothesis that there is some mysterious "thing in itself" that is not accessible to the senses but only to religious beliefs (of materialistic value). Matter is exactly what we can experience with our senses."
Also, James Culbertson expressed the idea that sensations are not in the brain.[38] More recently there is an article by François Tonneau *Consciousness outside your head* [39]. But to my knowledge the one who today in great detail defend this view is Riccardo Manzotti, professor in theoretical philosophy and Ph.D. in robotics and also a phycologist. He has among else presented this view in the book *The spread mind: Why Consciousness and the world are one*, [40]. His starting point is that even if it was a good hypothesis to search for experiences in the brain, no sensory experience has been explained by brain and there is nothing in the brain which looks as our experiences of an object. So, he formulates his main thesis as a slogan: *the experience of an object is the object we experience*. He has a very informative homepage [41] where you can find video lectures, articles and even instructive funny cartoons on the subject.
But since Galileo and Descartes formulated an absolute distinction between subjective experiences and material objects in the world, most of us are so accustomed to think, and are even convinced, that the only possibility is that conscious experiences exist in and are created by the brain. It is therefore easy to think that Manzotti's theory is impossible and absurd. But Manzotti responds very credibly, as I see it, to all objections.
But why is the view still so strongly held by most scientists that consciousness is localized in the brain and identical with matter in the brain? Or at least created by the brain?
L: Well, I must say it still sounds very new and radical, but also possible. And also, in a way liberating, because it describes what I actually experience, as I see things in space, my body and all else outside my body and brain. But what about my thoughts and dreams? They are not in the space outside me, so must be in the brain.

J: Very good question. Yes, I also think that what, *seemingly*, supports, or even *seemingly* proves, that brain produces experiences are our mental experiences, that is, thoughts, dreams,

fantasies, hallucinations, illusions and memories, etc. We can have dreams, which we cannot distinguish from reality, even when we don't see the physical world when we are asleep. Professor Revonsuo believes "... in the dreaming brain the phenomenal level is brought about by the internal brain mechanism alone, without any external stimulation or motor output going on. Thus, the dreaming brain shows us that consciousness itself - the entire sphere of experience - needs, for its momentary existence, only the internal activities going on in the brain." [42]. And we can think about objects that do not exist in the physical world. But Ludwig Wittgenstein said, "One of the most dangerous ideas for a philosopher is that we think with our heads or in our heads." [43]. And again we can remember what happened before and which does not exist now. "The memory must be stored in brain" "Mental experiences must exist in the brain" so most scientists say. So, first

Let us look for our memory.

Exercise 2.

J: We can both remember that when we first saw each other about an hour ago you were at the corner of the house, which we both can see over there, right?[3]

L: Yes, of course.

J: Good. Where is the location of the memory of the event when you were at that corner ?

L: Well, now you got a problem. We don't see any "me-like" body or object there. So, even if you argue that our sensory experience is out in space outside the brain, memories are not and so memories must be in our brains.

J: So most scientists believe, that the memory is hidden in our skulls where the brain is. But how? Well, to make a long story very short: Aristotle, or perhaps first Plato, said memory is impressions in wax. And we think we can understand[4] what he meant. Then came the tape recorder, then the computer that has huge internal memory, and brain as a computer is a popular picture. But now we have the cell phone. With a sim card and a code, we have access to a huge amount of sensory experiences, as videos and music, which are not stored in the cell phone's small memory but in the cloud[5].

And so it may be with our memory. The brain and a "code" in the brain should suffice, but the memory of the event itself does not need to be stored in the brain. But where? Actually, our memories don't have to be stored at all. Because as Albert Einstein's mathematics teacher professor Hermann Minkowski showed: everything that has happened still exists in the four-dimensional spacetime, with our 3 space dimensions, length, width and height and time as the fourth dimension and where everything that has happened, happens and should happen exists at once - spacetime is ontologically (at least) four-dimensional.

So, I claim that a species, which in the Darwinian evolution learn to use this objective always existing very great four-dimensional spacetime will have an advantage over a species which have to store everything in the brain. Because for the one who use the "spacetime library", so

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[3] Exercise for a reader of the article: You are now at place B. Previously you were at another place A which you still can see. Where is the memory of the event when you, your body, were at place A, where is that memory located? I suppose you don't' see your (physical) body at place A now.

[4] Stephen E. Braude, professor em. in philosophy, claims that it is logically wrong to believe that memories are stored at all, see e.g. Memory without traces, [Braude, 2014, chap.2].

[5] That is on big servers at other places in the space all over the world

to speak, the brain will be freer to do what the brain is good at and should do: effect our actions, at first for fight and flight, now better for creative cooperation for better life for the individual and the planet. And also, dreams can be seen as experiences of events existing in four dimensions beyond the brain and is thus not at all a proof that brain alone can produce all conscious experiences as professor Revonsuo argued.
L: Again, an interesting idea, but at odds with what is ordinary said. And injuries on brain effects memory. But that you can perhaps compare with a faulty cellphone.
J: Yes. A huge problem is that few brain researchers has understood what Einstein-Minkowski's revolutionary discovery of the objective four-dimensional spacetime really means. But as deep knowledge about consciousness has existed long before any mathematical physics existed, I am sure it is fully possible to understand the meaning about more dimensions and consciousness without training in physics, even if my own way to this insight was through studies and discoveries in mathematics and physics. I have written a very short popular introduction to Einstein-Minkowski's discovery that reality is, at least, four-dimensional and I send it to you as appendix 1.
L: Thanks, yes even if I have heard some about Einstein, four-dimensional spacetime sounds difficult. But if it is as you say I can see a possible relation to memory. Well actually only for that which has happened, not clear for facts and skills.
J: Very good. Yes, we have different types of memories. Here I talk about episodic memory, that is events that has happened just ones, as e.g. our first time falling in love. And this fits very well with that all events still exists in spacetime. I will come back to memory of facts and skills.
L: Ok. But why don't we hear so much about spacetime? Do all physicists agree on four dimensions? I have heard about ten or eleven and even more dimensions.
J: Good points. Today there is more talk about all strange things in quantum theory and not so much focus on Einstein's theory of relativity and spacetime. And in string theory with ten or eleven dimensions the extra six or seven space dimensions are considered so small that we cannot experience them, and thus not related to consciousness. Also, there are still discussions about how many dimensions there are in our world or spacetime among both physicists and philosophers, as I mention in appendix 1. But for the argument now I will take as evidence and support for more dimensions that in some NDE people talk about more dimensions.

Already in Moody's first book *Life after Life* one woman tells:

NDE example 4.
"As I was going through this, I kept thinking, 'Well when I was taking geometry, they always told me there were only three dimensions, and I always accepted that. But they were wrong. There are more'. And, of course, our world – the one we are living in now – *is* three-dimensional, but the next one definitely isn't." [44]

Actually, this NDE was very important for my further research. I had earlier discovered the possibility of six dimensions, three space and three timelike dimensions. But then I had no idea what these extra dimensions were, besides they made it possible to describe velocities higher than that of light. But this really shaked my materialistic word view. Because, it seemed to me, that then we have our material world with velocities lower than that of light, and a world of light, but also a world beyond that of light, whatever that was. This was 1971, before string theory so I got no support for studying extra dimensions and left theoretical physics without finishing my Ph.D. dissertation. [45]. When I later studied on medical high school and read Moody's first book about NDE, I first had the same strong feeling, as when I discovered the possibility of six dimensions, that there is more to our world than I learnt in

school. And secondly, the woman quoted, who so clearly told about more dimensions made me think: can these extra dimensions be related to these extra ordinary experiences?
L: An exciting but difficult question to study, I think.

J: Yes. I started to read all that was published about NDE and was deeply affected by these strong experiences. But famous neuroscientists said, as you, that it was just hallucinations in a dying brain. But fortunately, the psychologist and brain researcher Roger Sperry came to Stockholm in December 1981 to receive his Nobel Prize in medicine and physiology for research on people with "split-brains". Sperry and the other two medicine laureates met us medical students at Karolinska Institute, the Medical High School in Stockholm, for a discussion about scientific research. At the end our professor David Ottoson asked them "What do you want to see for new discoveries in the future?". Torsten Wiesel and David Hubel, who received the prize for studies on the visual cortex of cats, answered with a rather technical speculation about possible connections between different cell layers in the visual cortex. But Sperry answered without the slightest hesitation. "To know how the brain produces conscious perceptions" [46]. Roger Sperry who was a Nobel Laureate for his research on the brain he knew that neither he nor anyone else knew how the brain can create conscious experiences. Even if one were convinced that the brain creates consciousness, it is not enough as science, unlike belief, cannot be content with that, but must show how, describe how it works.
And Sperry, who tried to go a middle way between materialist monism and dualism [47] wrote the same year he received the Nobel Prize:
“Social values depend directly or indirectly on whether we e.g. believe that consciousness is mortal, immortal, reincarnated or cosmic and whether we perceive consciousness as localized and bound to the brain or essentially universal, etc. " [48].
So, it was very clear that no one knew how to explain consciousness, so I continued my research about if these six dimensions can be a possible way to describe consciousness including near-death experiences.

Near-death experiences and more dimensions.

As we said, people who have been physically close to death and who still survived, sometimes have an OBE and can "see" what happened in our world both close to their body and even far away, which also sometimes seems to have been correct [49]. Many people who still believe that the brain can create consciousness dismiss all this, like you said, as just hallucinations caused by a lack of oxygen in a dying brain. But since no one has been able to show how even a single one of our normal everyday sensory experiences can be created by the brain, we have every right to take these experiences for what they seem to be, at face value, and instead see if they can teach us something new about consciousness and what mainstream science calls "The mystery of consciousness".

NDE example 5.
Anita Moorjani wrote that her cancer progressed and how she got into the hospital and everyone, including the doctors, was convinced that she would die that night. But she survived. She had an NDE where she among much else experienced:
“I began to feel weightless and become aware that I was able to be anywhere at any time. … It felt normal, as though this was the real way of perceiving things.” [50]. "It felt like I could be everywhere at the same time". [51]. “Time felt different in that realm too, and I felt all moments at once. I was aware of *everything* that pertained to me - past, present and future - simultaneously. " [52].

This includes a very good description of what it could be like to experience a four-dimensional spacetime where time is the fourth dimension. For me as a physicist, this experience supports Einstein-Minkowski's four-dimensional spacetime and that it can also be experienced in its four-dimensionality in an alternative state of consciousness, as when the brain does not function normally in a bodily near-death experience, and consciousness then can include more of spacetime than during normal wakefulness.
In appendix 1 you can see more about how spacetime can be illustrated in two and three dimensions. But we cannot draw four dimensions, so we use this illustration of four-dimensional space-time (Figure 2) where each point on the time axis is our entire three-dimensional universe at that time (defined by *one* observer[6]).

Figure 2

L: Interesting, but speculative. How can consciousness be related to spacetime? And I have read about critique of 4D spacetime, that if all events, in the past, in the present and in the future, exist "simultaneously at once" in the four-dimensional spacetime, then how can we experience change, which is fundamental to human experiences? How can we experience that "time passes", “the flow of time “?
J: You are quite right. And even more:
If all future events already exist, the future is, apparently, completely predetermined, which contradicts the quantum theory that describes many possible futures.
It also, even more importantly, contradicts our strong, and for moral actions necessary, experience that we can and must choose between possible actions.
These problems are still under lively discussion among both physicists and philosophers, and some also argue that it concerns consciousness [53]. I believe that all these problems can be solved in a multidimensional spacetime, as in an extension of Einstein-Minkowski's four-dimensional spacetime to a six-dimensional spacetime, with three space dimensions and three time-like dimensions, which I and some other physicists are working on [54, briefly see Appendix 2], and which I think at the same time can be a better model for consciousness.
Also, Bernard Carr, emeritus professor of mathematics and astronomy, believes that in order to explain consciousness, the everyday, the parapsychological and the spiritual, more dimensions are required than three spatial dimensions and one time dimension [55]. And Jean-Pierre Jourdan, M.D. also argue for interpretations of NDE with more dimensions [56].

Consciousness in six-dimensional spacetime. A hypothesis. [57].
In analogy with the illustration of 4D spacetime where each point on the time axis or timeline is a whole 3D universe at that time, we can now use two of the three time dimensions for a time surface, (Figure 3) and suggest a solution to the problems mentioned above. Each point in the two-dimensional time surface is a *possible complete 3D universe.* There are then many *possible* future universes and which possibility which becomes a *manifested physically real world* is not predetermined and therefore in accordance with quantum theory. Because which possibility which becomes a manifested real world is determined by all free and independent

[6] Simultaneity is relative so there is no universal now and people who move relative to each other have different sets of events in what is the whole world now, see figure in Appendix 1, but the difference is negligible for everyday distances and speeds. And the argument still applies for each observer individually.

choices by all conscious beings[7] as the simplified example in Fig 4 shows and is therefore also in accordance with our experience that we can make choices and influence the future. .

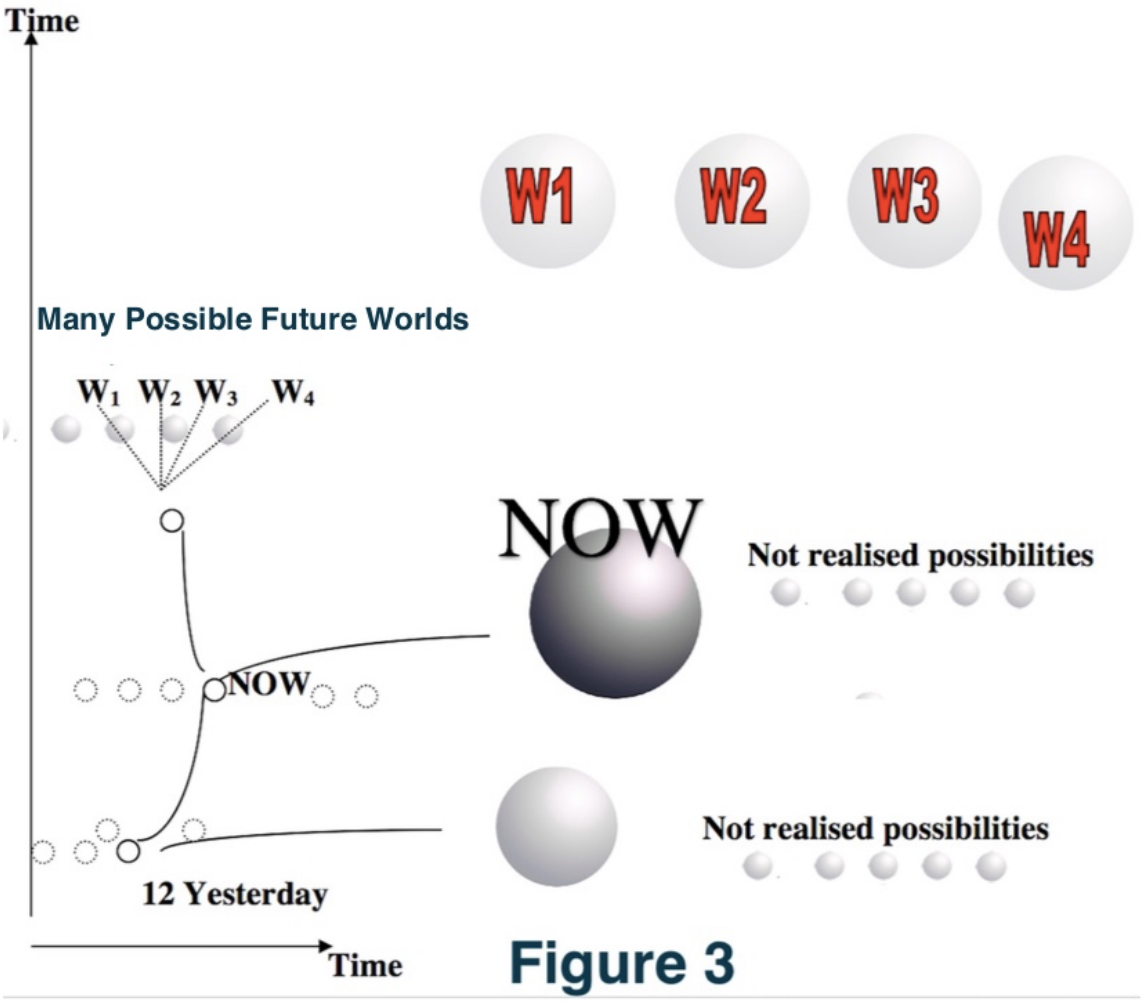


Figure 3

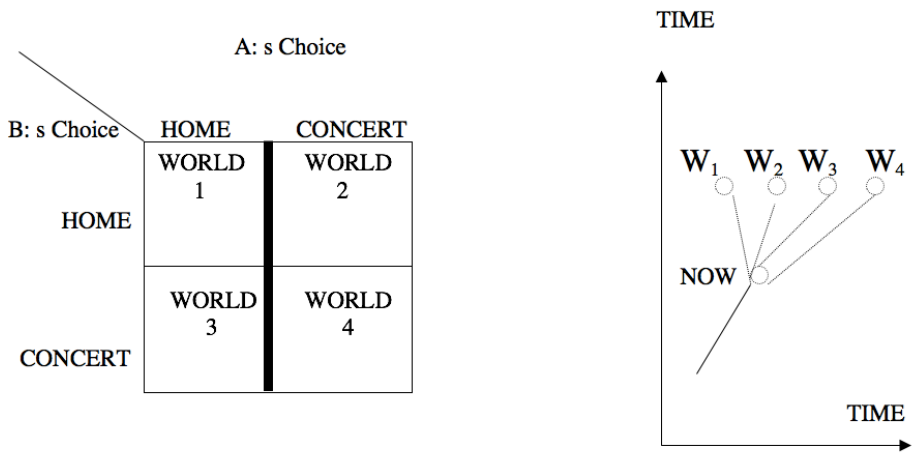


FIG. 4 CHOICES OF POSSIBILITIES DECIDE REALITY

I come back to the flow of time.

[7] This includes everything that has consciousness, in a "panpsychist" sense: humans, all animals, elementary particles. And also, all beings greater than man.

I now suggest that we can get a better understanding of consciousness with the help of the six-dimensional space-time:

Sensory experiences are in the present, the NOW, and identical with material objects in the present, in the physical body and in space outside the body, but not in the brain. The "spheres" / (circles) are the whole world at a "2D time", so an individual's sensory experiences are only a small part of NOW/SENSORY EXPERIENCES.

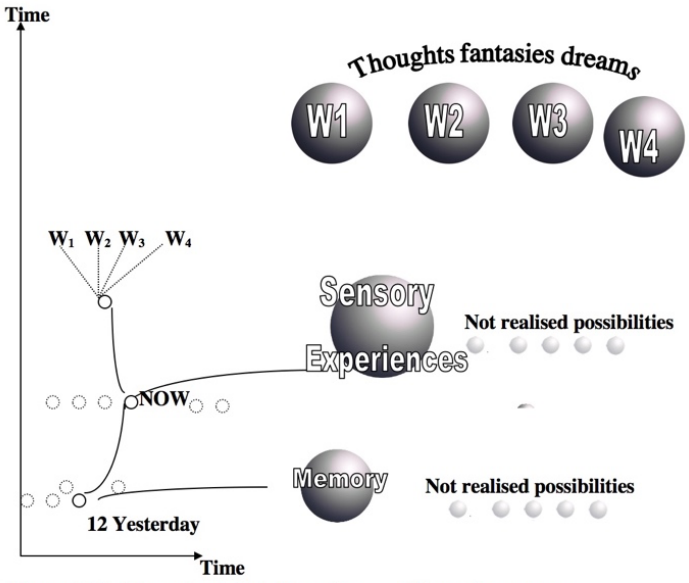


Figure 5. Six dimensional 5+1 Spacetime

Mental experiences are in time outside the present, the NOW, and thus outside the brain. The memory is previously realized events in spacetime before the present. Thoughts, visualizations of the future are possible events in possible future worlds in spacetime. Fantasies, dreams, false memories and hallucinations are possible events in possible worlds that have not been materialized as real. An individual's memory is again a small part but of many previously realized whole worlds at different times. Also, an individual's other mental experiencers are a small part or a subset of many possible worlds. The unrealized possible worlds still exist in space time.

Abstract thoughts and semantic memories are interpreted as possible speech in possible worlds. Hegel said: what is real must once have been possible. But what is possible can happen but does not have to happen. I can say 'Pythagorean theorem', but I can think of saying it in a minute, which is a part of a possible world in a minute, but I can then choose another possibility where I do not say it, then it remains a thought.

You also had a question about **facts and skills.** Memory of facts can be seen as the memory of the event(s) when we saw or heard about the fact and/or as a semantic memory. Concerning skills there are animal experiments showing increased and new neuronal connections due to training. Also, in humans one can see correlations between learning and brain growth. So, an acquired skill through training can be seen as a neural motoric program. But I doubt that this is the whole truth. There are so called savants who have some exceptional talents. One man could hear a long rather complicated piano piece once and could then play it correct. That is, he had acquired the skill without training. So, I am inclined to think that motoric programs can exist as objective structures in spacetime, which can be "downloaded" by others under special circumstances.

Emotions can be described as a composition of and a tension between, life story, memories, thoughts about what happened, experiences in the present, including in the body and worrying or hopeful thoughts about the present and the future.

So, for an individual the content of consciousness is a) the sensory experiences = a small part of the world now and b) the mental experiences= a small part of earlier worlds and possible worlds.

L: Seems possible as a hypothetical description. But what is spacetime and possible worlds? And what does the brain do then?

J: Let me come back to what spacetime is. In this view the brain does not create the experiences, they exist in spacetime independently of the brain. The brain limits our consciousness so that we experience a part or subset of spacetime.
L: I have heard something like that, that the brain is like a receiver or a filter.
J: Well, but the radio receiver analogy or perhaps even the filter analogy can give the impression that some signal comes into the brain and that consciousness is created by the brain. I claim we never have any conscious experience in the brain. So, a more suitable, but very simple, analogue for this view is that you, or better "the I" or the center of consciousness, are inside a house, which symbolizes the brain. The house has many windows which have shutters, and opening different shutters make it possible to see different parts of the real world outside the house. The house also has doors which can be opened so you can go out in the real world outside the house/the brain in analogue to an OBE. As long as you are inside the house the quality of the windows and shutters affect your experience of the world outside the house. But the house doesn't create the world outside the house, which exists independently and of the house, and are identical to your experiences. Changes in shutters and doors correlate with experiences. And in reality, the brain processes that correlate with experiences are traces of the movement of consciousness in spacetime. The brain / body is our instrument for action in the physical world. So, the brain still has an important but quite different function.
L: If so yes. It might be a possibility but far from accepted views and very speculative.
J: Agree. But as mainstream science has nothing constructive to say how experiences are created, what "stuff" they are made of and where they are located, I think the only scientific way forward is well-grounded speculations, or conjectures [58]. I claim that this view is compatible with all our conscious experiences including NDE and I further believe that near-death experiences even provide support for this understanding of consciousness in the six-dimensional spacetime, as in the following examples.

NDE example 6.
A woman came to the emergency ward with abdominal pain and had a severe bleeding due to ectopic pregnancy. She became unconscious (seen from the outside, i.e. actually unresponsive) but fortunately survived and was able to tell afterwards what she experienced: She felt as if she was leaving her physical body and saw it from above lying lifeless on the stretcher. She saw a nurse and a young doctor. She said that in this condition she could *hear the nurse say*, 'You have to call a chief doctor'. But she said she also saw how the nurse thought 'You your clumsy idiot is not doing anything right'. [59].
My understanding in 6D spacetime: When the woman outwardly was unconscious and her brain did not function as usual, she could experience more of the six-dimensional spacetime. She experienced the physical sound waves in the present as ordinary hearing experiences. But she could also experience the possible world where the nurse could say 'You your clumsy idiot ...' But she did not hear it but says that she saw it, i.e. for her it was a decisive difference. Such a thought is a possible speech, which exists in a possible world, but one thinks what one can say without saying it, as a possibility that is not realized in the real material world. And the nurse was polite enough not to say 'You your clumsy idiot ...' just think about it.
But the woman could still experience this nurse's thought = possibility of another speech that was not realized into physical sound, so the woman did not hear it but "saw" it.

NDE example 7.
My colleague, the anesthesiologist and NDE author, Göran Grip has also previously written about his own NDE [60].

"Time was not passing in the usual way. The episodes of my life were not replayed like in a movie. Instead, an entire episode - with its beginning, its middle and its end – stood out as a unit: it was possible to *see* simultaneously every little action or spoken word with its thought and emotions (my brother's and mine) attached to it. With an adult description it was as if we were to wonder about, back and forth in a static landscape the features of which were not trees and hills, but of actions, words and emotions. His suggestions (for a more loving attitude on my part) was there at the same "time" - as an alternative landscape that was superimposed on the original one. "

My understanding in 6D spacetime: (which Dr. Grip also thinks is reasonable [61].) The experience of an entire episode, beginning, middle and end is an experience of a larger part of the four-dimensional spacetime where time is experienced as an extended fourth dimension, as a "wall hanging in time". Walking back and forth in a static landscape of actions, I interpret as meaning that he could wander between earlier episodes and later episodes in his life, as if his life was extended with time as the fourth dimension of a four-dimensional reality. Past, present and future existing at once in a fourdimensional landscape. And since walking in a landscape takes time, this indicates that there is another time that flows, in addition to the usual time with past, present and future, now seen at once as the 4th dimension. He experienced his brother's feelings. In the six-dimensional spacetime, all experiences exist objectively (in the two-dimensional time surface), although our brain usually limits our experience to our own (thoughts and feelings). But when the brain does not function as usual, e.g. in an NDE, we can experience more of all the possibilities of spacetime, including the feelings and thoughts of others. And that the brother's proposal for alternatives was there at the same time as an alternative landscape supports that there are several possibilities for action, i.e. several possible futures and these can be described as a two-dimensional time space, or perhaps better a two-dimensional space of possibilities. A two-dimensional space of time or possibilities where each point is a possible whole three-dimensional spatial world, which in total becomes a five-dimensional space-time, a five-dimensional block universe and where the experience of wandering in this five-dimensional landscape / spacetime requires another time dimension describing change, how time passes, so a total of six dimensions, three spatial and three time-like dimensions.

NDE example 8.
Reverend Peter Panagore talks about his NDE [62].
"Timelessness as all time and no time. All future, all past, not just linear past and linear future but time expands in three dimensions rather than in one line."
Later he also tells how he experiences the pain he had caused in others.

NDE example 9.
Anita Moorjani also experienced this in her NDE: "I seemed to just know and understand everything - not only what was going on around me, but also what everyone was feeling, as though I was able to see and feel through each person." [63].
This experience again supports the interpretation that what a person sees and feels are objective events in spacetime that can be experienced by others whose consciousness is less limited by the brain and instead can expand and experience more than usual of objective spacetime.

L: Well, very interesting experiences. But even if your speculative interpretations are possible, it of course does not prove they are correct, as with Russel's teapot. And why do you think more dimensional spacetime is better than brain or even super psi?

J: Yes, this is very important. Besides what we already discussed that not even ordinary sensory experiences can be explained by brain, and that there are no theories for psi, I think that a prominent feature of NDE supports an interpretation in more dimensions. Here some quotes from NDE research which support that:
"In fact, most experiences are quite certain about the reality of their NDEs and describe them as 'realer than real' or 'more real than anything else I've ever experienced'." [64].
"Susan Litton, who had an NDE at age twenty-nine told me, 'There was no sense of doubt whatsoever. Everything had a sense of being 'more real' than anything that would normally be experienced in the physical world as we know it.'" [65].
"Three-fourths of the experiencers in my research [many hundreds] described entering some unfamiliar realm or dimension." [66].
And Moody writes "The persons involved [in NDE] uniformly characterize their experiences as ineffable, that is 'inexpressible'". [67].
"Jayne Smith, who had an NDE at age twenty-three during a bad reaction to anesthesia during childbirth told me, 'Never, ever did I think it might have been a dream. I knew it was true and real, more real than any other thing I've ever known.'" [68].
L: But there are different qualities to dreams.
J: Sure, dreams and hallucinations can be experienced as real, but they are not described as 'realer than the real'. But also, most NDE-ers say they can't describe what they experienced, there are no words to it.
"People often describe their NDEs as occurring in some realm so different from our everyday physical world that they feel that our words are not adequate in describing them" [69].
"'It's impossible to describe. It truly can't be put in words. … there is nothing I can draw reference to in my life to begin to explain it.'" [70].
"Although I try to share my near-death experience here, there are no words that can come close to describing its depth and the amount of knowledge that came flooding through." [71].

Again, the woman Moody wrote about:
"Now, there is a real problem for me as I'm trying to tell you this, because all the words I know are three-dimensional. As I was going through this, I kept thinking, 'Well when I was taking geometry, they always told me there were only three dimensions, and I always accepted that. But they were wrong. There are more. And, of course, our world – the one we are living in now – *is* three-dimensional, but the next one definitely isn't. And that's why it is so hard to tell you this. I have to describe it to you in words that are three-dimensional. That's as close as I can get to it, but it' really not adequate. I can't really give you a complete picture." [44].

When you had a dream is it a lack of words which is the problem to describe it?
L: No, mostly it is a vague memory, but I can describe what I remember.
J: Yes. And I think that the so common testimony that NDE are experienced as 'realer than real' and are difficult to describe as there are no words for it is evidence of an experience of more dimensions than usual, which the woman so aptly described. For our words relate to three dimensional objects and verbs for change. But how does one name a four-dimensional object e.g. 'a seed being planted in earth-a growing sprout-a blossoming flower -a withering flower' as *one* object?
L: Hm, make some sense. But could it not be a hallucination?
J: So, we are back there again. But what is a hallucination? As I said before as brain believers have not explained even one ordinary daily experience with the brain, they ought to be more humble than saying that the brain can create almost everything as hallucinations. They act as one who says, 'Give me one miracle and I shall explain everything'. Yes, if they got for free

the miracle that the brain could produce experiences, then, of course, all the rest can be explained by hallucinations. But if we get the miracle of conscious spacetime, we can also explain everything, even life after death.
L: Yes, it at least seems fair.
J: And what can be hallucinated? Those who believe in the brain put no limit to what a brain can hallucinate, so it cannot be falsified. But this is not science but a belief, if using Popper's criteria for science. So, if they accept Popper's criteria and don't agree that their view is not science but a belief, they must describe at least *one experience* which is possible in this life before death *which they must accept as a falsification of their brain view*. I have many times asked for that, but mostly met with silence. The chairman in a Swedish skeptics' organization once honestly admitted it was a good question, and he suggested some parapsychological phenomena. But these most mainstream scientists don't accept, or they are thought to be able to explain them with the brain. And professor Jessica Utts have also "asked the debunkers if there is any amount of data that could convince them, and they generally have responded by saying, 'probably not'." [72]. So, I think this is an expression of dogmatism and not science.
L: Ok, but it seems equally impossible to falsify that consciousness can exist without brain.
J: Yes, you are right, it is not possible to falsify at all, that consciousness can exist without the brain, as one cannot prove non-existence for logical reasons. So, I agree it is in this sense also a belief but can of course be true. And scientific fairness must mean that both beliefs, both hypotheses are accepted for serious research. But let us see if we can still go further by inviting my friends from Flatland.
L: Flatland?

An excursion to Flatland

J: Yes. In Flatland there are only two space dimensions, forward-backward and right-left, but no up-down. So, the Flatlanders can only experience length and width but not height. They also experience changes in their two-dimensional world as their time goes. The English schoolmaster, theologian, and Anglican priest Edwin Abbott Abbot wrote about journeys to Flatland in 1880.ies [73], that is before Einstein-Minkowski's four-dimensional theory. It is first an allegorical critique of the class society in England: e.g. women were dangerous as they were pointy triangles almost like needles which could hurt you. Soldiers were more blunt triangles, not equally dangerous. Decent businessmen were squares and priests, of course, circles. Flatlander, of course, does not see each other from above, only from the side and from difference in light reflection had learnt if the lines they see are part of triangles, squares or circles. But then Abbot writes about the possibility of higher dimensions. E.g. if Flatland scientists see a point-like object suddenly coming into existence "from nowhere" and then growing into a line, then shrinking and disappearing to nowhere they could think it was a living being coming out of nothing. Remember that beings in Flatland are seen as lines, or complex of lines. And probably they will call it a ghost. But as many Flatland scientists have seen this phenomenon and even registered it objectively with Flatland instruments, they could not deny the existence of this ghost even if they had no clue to any explanation.
L: Ok. But what does it have to do with more dimensions?
Wait a minute. Ghosts seemingly come from nowhere. But if perhaps Flatland exists in our 3D world and a 3D ghost moves through Flatland?
J: Clever, that was exactly what Abbot meant to illustrate. In this case if a 3D ghost (the thickness is perpendicular to the paper)

like a rhomb
moved through Flatland,

what they experience in Flatland is a red point coming into existence from nowhere, a growing red line, then shrinking and disappearing. Let us imagine that Flat-Einstein has developed his theory of relativity where Flatland time is a third dimension in their 3D spacetime, and identical to our third dimension of space, that is height. So, every 2D object or process in Flatland exists as a 3D object.
L: But here is a problem. Even for Flat-Einstein in his 3D spacetime. Even if having objects with height, 3D spacetime is completely static, so the objects cannot move and give the experience of growth.
J: Very good. This is exactly one of the main critiques of 4D spacetime in our world. For 3D objects to move in 3D space we must use our time in our 4D spacetime, and we can suppose that Flat-Einstein or more plausible Flat-Minkowski discovered that [45] and added our time as the fourth dimension to their 3D spacetime. This is difficult to draw but can be presented in animations, on my homepage, I send you the link[8]. In analogy we in our world need an extra time to make change possible in our 4D spacetime
L: Ok. But how can that lead us further on consciousness?
J: Well, imagine that Flat-Moody had an NDE and experienced the world as we do. He saw the rhomb like ghost move through Flatland and that it looked exactly as the growing line ghost in the flat Flatlander perspective.
L: Ok, but then?
J: Well, what do you think happens when Flat-Moody is back in Flatland in normal flat mood?
L: Well, he now knows that there exists a third space dimensions, which is Flat-Einstein's time in the 3D spacetime, but also that it exists an extra time, a fourth dimensions, which allows movements in the 3D spacetime.
J: Yes, very good.
L: But he can't point in the third or fourth dimension, so he can't explain it to still flat Flatlanders.
J: Exactly. He can describe it mathematically to Flat-Einstein and Flat -Minkowski (see appendix 3) who were very happy about that their spacetime was possible to experience and thus that there was evidence that 3D and 4D spacetime exist. But the other scientists, especially the Flatland brain researchers, dismissed Flat-Moody's talk that 'it is realer than real, but I can't point to what I saw as nothing like it exists here in Flatland, for I experienced a third and a fourth dimension'. The Flatland scientists were annoyed and said that this was impossible as it blasphemously contradicted the first commandment in Flatland Science, 'Thou shall no other dimensions have than two'. So, they said it was as a distorted view of reality and a psychotic hallucination. But Flat-Moody insisted that he knew it was real, he had experienced both a third and a fourth dimension.
L: But could he not be mistaken about the number of dimensions?
J: I think not. Dimensions of space in the physical sense are not pictures or any vague experiences, but the number of independent directions of motion. So, I will claim that how many space dimensions there exist, and which we can experience, is a very basic and robust experience. If we were Linelanders we could just move back and forth a long line, that is a one-dimensional space and one time dimension for possibility of movement. If we were

[8] https://www.drpilotti.info/eng/conscious-spacetime.html Choose animation,

Flatlanders we could move back and forth and right and left, that is two-dimensional space and one time dimension. Also, for us Spacelanders being able to move back and forth, right and left and up and down, there is no doubt we experience three space dimensions and one time dimension. So, I claim these experiences will be easy to differentiate, so it is a very robust fact how many dimensions we experience. Of course, most of us have difficulties to imagine experiences of higher dimensions. But I argue that this is exactly what many experienced in their NDE, and which is the cause of that it is experienced more real than real and they have no words for it.
L: Ok, but could the extra dimensions be a hallucination, that is just created by the brain?
J: Well, this is a fundamental question, let me come back to that.
Flat-Moody further argued that he had an explanation to the phenomena of ghosts, which no other has solved: ghosts were not coming from nowhere but exists in higher dimensions. This explanation of an unexplained phenomena strengthened Flat-Moody, Flat-Einstein and Flat-Minkowski in that their theory about three and four dimensions was describing reality.
So, I think, this shows that a Flatlander can have a true and convincing experience of really existing higher dimensions, but which majority of flat Flatlander can just dismiss as nonexciting or at most "explain" them as hallucinations produced by the brain.
L: Yes, so it seems, and we are back in that the question is undecidable.
J: Not exactly. I have some more ideas which might get us a bit further by finding that there actually are limits to what can be hallucinated, what a brain can create.
L: Interesting, what is that?
J: Two thought experiments inspired from Flatland. First, it seems self-evident that there can exist no 3D object, with length, width and height in Flatland, where there is no height at all. And neither the experience of three independent directions of motion in space when there are just two space dimensions. So, it is conceivable that if a Flatlander yet had an experience of a 3D object or three independent directions of motion, these experiences must also exist outside Flatland, and thus also outside the 2D brain.
L: Well it seems so.
J: Secondly, it is possible to imagine that a flat magician in Flatland from a flat hat can bring out a flat cat, by a trick. But it is not possible to imagine that, even if you are a flat magician in Flatland that with a trick you can get a real three-dimensional cat from a two-dimensional hat. This trick requires a three-dimensional hat that cannot exist in Flatland. So, from two dimensions we cannot get, create, produce, "emerge", something with three dimensions. And generalizing: from three not something with four, from four not something with five and so on.
L: Well, besides that Flatland does not exists it seems to work as thought experiments.
J: Thanks, and this is a method sometimes used to generate new ideas.
So, from these thought experiments in Flatland my mathematical conjectures are:

Back to our world and mathematical conjectures

1. An (N+1) dimensional structure cannot exist within an N dimensional structure.

2. An N-dimensional structure can in no way create, produce, give, "emerge" an (N + 1) -dimensional structure. [74].

L: The first seems self-evident as you said, but the other is more to ponder about. But how can that help us further?
J: Our brain is a three-dimensional structure in our three-dimensional skull but exists, like all objects, extended in time in the four-dimensional spacetime, i.e. our brain is, in fact, a four-

dimensional structure. But if the first conjecture is true, which I think is rather obvious, a five-dimensional experience [=experience of 5 dimensions] cannot exist in our 4D brain but must exist also outside the 4D brain in an, at least, 5D spacetime. And I mean that the near-death experiences I told you about (Ex.6., Dr. Grip's and Rev. Panagore's) are best explained as five or even six dimensional. This then is a strong evidence that the prevailing materialist view, as it is expressed by professor Revonsuo, is wrong: "Phenomenal experience simply has no physical escape routes (at least none that science knows anything about) to get out from the brain. Thus, consciousness must reside somewhere inside the confines of the brain." [75].
L: Well, this really seems to be a striking counterargument. But if you mean that these 5D experiences are evidence for that we really live in a world of at least 5D, why could not also the brain be 5D and thus still the 5D experience be in the brain?
J: Good question. But we must be careful here. We know of our 3D brains in our 3D skulls and that the body and 3D brain disintegrate at death. Which you argued was evidence for that consciousness could not exist after death.
L: Yes.
J: But the 3D brain exists as a 4D object in spacetime, between birth and death. If there are some structure connected to this 4D brain in 5th or higher dimensions you also will call "part of the brain" we have today no knowledge at all of what that is and can therefore not argue that this part also must disintegrate at the death of the 3D/4D body and brain. And if experiences can exist even in a supposed 5th dimensional part of the brain as you suggest your argument against consciousness after bodily death based on disintegration of 3D brain have no force at all.
L: Ok, I see what you mean and of course agree.

J: But not all "brainmaterialists", that is those who believe that the brain can create all conscious experiences, agree with professor Revonsuo that "Phenomenal experience simply has no physical escape routes (at least none that science knows anything about) to get out from the brain". The professor emeritus in psychology Max Velmans argue in his theory *reflexive monism*, that by *perceptual projection* phenomenal experiences are projected from the brain out in the world.[76].
But can a 4D brain project anything of 5 and more dimensions? I doubt that.
If also the second mathematical conjecture is true, a four-dimensional brain cannot create, "emerge", anything, not even as a hallucination or a projection, with five or more dimensions. And, as I argue, the NDE examples (Ex.6., Dr. Grip's and Rev. Panagore's) are best explained as five or even six dimensional, which then cannot be created by (only)[9] the brain. And First again support both that it exists more than four perceptible dimensions in our world and that there are experiences that are more than and outside the brain. Secondly even if a part of the experience is in and depends on the 4D brain, the greater part of the 5D experience exists outside and independent of the 4D brain and seemingly is not affected even if the 4D brain disintegrate[9]. And this is, at least compatible with, and also support that conscious experiences can exist without the brain and so even after physical death. So, can count as evidence for survival of consciousness.

L: Again, interesting ideas, but speculative. It is then not a full proof but yet evidence for consciousness after death.

[9] Strictly this shows that brain is not sufficient, but not that the brain is not involved or necessary see appendix 4.

Open questions

J Yes you are right. There are still some steps to fulfill. But to identify sensory experiences with the objects outside the brain and body seems plausible as the objects have the same qualities as the experiences[10] and are also located in the right places, outside the brain. And the mental experiences are identical with what exists in spacetime. Yet it seems not evident that there yet are any crucial experiences which prove which hypothesis is right and which are wrong. It is often much simpler in physics. As for example Einstein's theory of general relativity showed that light is bent when passing a heavy object like the sun, but Newton's theory of gravity had not this conclusion. But if it was added to Newton's theory that light is bent by gravitation one got an angle which differed from Einstein's prediction. But observation showed Einstein was right. We don't have such predictions concerning consciousness as seemingly no theory can list what experiences are possible and which are not.

Further research

But if it is possible to prove the second mathematical conjecture and also find more support for experiences with more than 5 dimensions in NDE, I think we come very close to a proof of that consciousness can exist independently of the brain. I have got some support that the mathematical conjecture that N dimensions never can give (N+1) dimensions is true and even can be proven, but also some critic indicating it is false. [77]. So, the question is not settled, and I hope that more skilled mathematicians will tackle this problem. Also, when people have an NDE they are occupied with more important experiences than counting dimensions. So, I hope also to find "psychonauts" that is people who at will can induce an OBE and be trained and prepared to count dimensions.
With these two areas of further research I hope and think the question about consciousness after bodily death can be given the strong answer yes.

Oh, time is going fast. We can continue another day, but now I must hurry up to finish my essay before deadline. But let me just say something about the more difficult questions we have left and then sum up.

Difficult questions

I have argued that NDE:s are evidence of that our consciousness exists in a reality with more than four dimensions and seemingly to some extent can be described in a spacetime with six dimensions. But what is spacetime? What is the stuff of spacetime? This is usually not answered in physics which take space, time and matter as basic concepts. But interestingly professor Herman Minkowski, when he first introduced the four-dimensional spacetime or what he called 'the world', also wrote:
"A point of space at a point of time, that is a system of values x, y, z, t, I will call a *world-point.* The multiplicity of all thinkable x, y, z, t, systems of values we will christen the *world.* [78] but also
"No to leave a yawning void anywhere, we will imagine that *everywhere and everywhen there is something perceptible*." [ibid. my italic]

[10] E.g. the experience of a red apple is red, round, shiny and "aplish", like the physical apple itself

Now I see this as almost prophetic as Minkowski already 1908 expressed a deep connection between world or spacetime and perceptibility, i.e. conscious experiences. Unfortunately, Minkowski left this life to early at the age of 44, due to appendicitis. I wonder what could have happened if he had stayed here as I argue he could have discovered six-dimensional spacetime [Pilotti 2020]. Perhaps he could also have expanded on the connection to consciousness.

Coming from physics and seeing the possibility to describe NDE and ordinary consciousness with more dimensions, I first was inclined to think that we could explain consciousness with physics, albeit an extended physics. But the more I have studied consciousness, and realized Minkowski's talk about perceptible spacetime world, I now think that consciousness comes first and we from our conscious experiences construct physics and spacetime. We have direct knowledge about what we experience, and this cannot be explained by something else, something we don't know what it is. Physics starts with our experiences of objects, which can move. So, we describe space and time. Then we have formulated a mathematical theory for that and discovered spacetime. And then we can theoretically discover new possibilities as more dimensions. But in the end, this must always be connected to conscious experiences to be real.
And I will say that our sensory experiences are not in brain, neither are they any brain processes, but they are identical with the objects in the world outside and independent of the brain. And I agree with professor Manzotti that our consciousness, at least our sensory experiences and the physical world is One. But what is the stuff of the physical world? Manzotti is a physicalist and says that it is physical matter and assuming that matter comes first he formulates his view in the slogan: "one's experience of an object is the object one experience".
This might be so. But as this relation between consciousness and object is an identity we can also say "the object one experience is one's experience of the object". That is taking conscious experiences as the basic stuff. And as Minkowski saying that everywhere and everywhen there is something perceptible.
And as I think NDEs are real and telling us about a broader reality and a broader consciousness, I think there is more to learn from these experiences. As for instance in what Anita Moorjani writes:

NDE example 10.
"I realized that the entire universe is alive and infused with consciousness, encompassing all of life and nature. Everything belongs to an infinite Whole. … We are all facets of that unity - we are *all* One …" [79]. "I also felt as if I was connected to everybody… I felt as though we all shared the same consciousness." [80].

This I think is evidence for that there is One Consciousness. And I think it to some extent can be described in six dimensional spacetime, although it is much greater than that. And the consciousness of each individual is a part or subset of that One Consciousness, and our body and brain limit our consciousness to that part. But who am I? I think it is impossible to express that in terms of something else, which we know less about than our I, which I see as basic in all our experiences. You said when we started our talk that an evidence for that brain produces consciousness is that we always have our brain with us. But not so in dreams or even more clearly in OBE. I will say what we always have with us in our experiences is our I, which then is basic and known as the experience "I AM" and cannot be explained by anything other or less. And in line with Anita Moorjani and many mystical experiences I think we ought to say that there is only ONE I AM, which is the same in all. [81].

L: Very fascinating. But is this really science? Are we not back to religion?
J: Ok, not mainstream science. And admittedly addressing questions which have traditionally been in the domain of religion. But still based on experiences. I do believe that the scientific method can lead long and I think we can extend the domain of science but it must then be openminded for a greater reality including NDE, parapsychology and spirituality.
Also, I will comment on the OBE experiences when not only the experiences of objects are outside the brain but also the focus of consciousness, that is the point in space, (and time), from where the experiences are seen, are outside the body. This of course is a very special experience which at face value speaks against production by the brain. Yet there are speculations that even this can be produced by the brain. [82]. But I have again the same critique. Show first how the brain can produce just one normal daily sensory experience, before speculating that the brain can explain the experience of being outside the body and brain. And I think that identifying conscious experiences with spacetime outside the brain is closer to that also "I AM" can be outside the brain and more in contact with the ONE CONSCIOUSNESS which can give experience like Anita Moorjani's
"I began to feel weightless and become aware that I was able to be anywhere at any time. … It felt normal, as though this was the real way of perceiving things." [50]. "It felt like I could be everywhere at the same time". [51].

Summing up

There is no explanation of how the brain can create even ordinary daily sensory experiences, so the brain hypothesis has not given any solution of that in 200 years.
The radical idea of spread mind, that consciousness and the world is one, that experience of an object is the object we experience, so that experience are identical to objects in the world, on the contrary is a possible explanation.
There are good evidences that psi exists - but no explanation for that either.
Some mediumistic and reincarnation cases, which at face value support survival, can according to Braude also be explained with super psi, even if he argues that survival is the better explanation.
But we have no explanation of super psi, especially not from the brain.
NDEs indicate that there exist more dimensions.
One possibility for more dimensions, which also can be experienced, is an extension of Einstein-Minkowski's spacetime to six dimensions.
Consciousness is identical with spacetime. Sensory experiences are identical with ordinary physical world in the now and mental experience are identical with higher dimensions outside the now.
The object we experience is the experience of the object.
I claim this gives a better understanding of all experiences, normal, paranormal, NDE and spiritual. So, it is better than brain and even super-psi. And in this view, partly based on evidence from NDE, consciousness is not produced by brain but exists independently of the brain, and is in and identical with spacetime, which in higher dimensions can be eternal, so a strong support that consciousness can exist even after permanent bodily death.

Appendix 1

A crash course in Einstein-Minkowski's spacetime physics

In physics we describe where objects are located and to that end, we use a coordinate system where every place or point could be named by numbers e.g. in two dimensions (x, y) = (5, 3) in S. Mathematics is democratic so we can chose another system S' where the same point has another name $(x', y') = (2,1)$

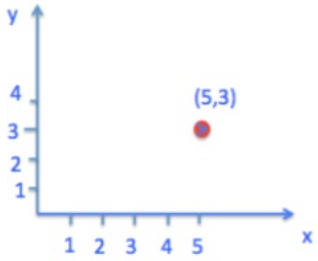


Figure 6

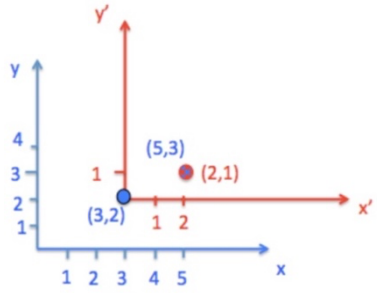


Figure 7

And it is easy to see how to translate the names from one system to the other knowing that Origo in system S' has name (3,2) in the first system. This is called a transformation between S' and S and we see that x=x' +3 and y=y' +2.

Our space has length, breadth and height so we need a three-dimensional system with (x, y, z) to name a point in space. In physics it is also important to describe what happens in moving systems, so we need transformations to such systems. And we see that

x=x'+vt

y=y'

z=z'

which is the transformation Galilee used and Newton added the important belief that time is absolute as given by God and the same for all, that is t=t'.

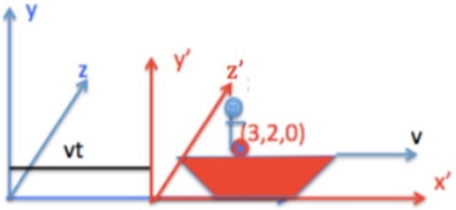


Figure 8

x

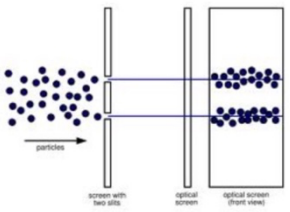


Figure 9

Physics studies particles which when hitting a wall just go through where there is a hole

but for waves we get an interference pattern as the two holes act like dropping two stones in water

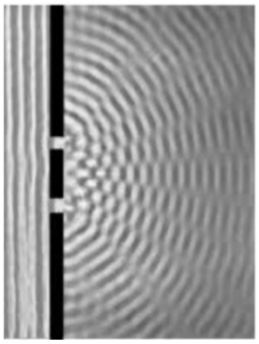


Figure 10

So, this is a way to differ particles and waves.

Einstein's theory of relativity is much about light. But what kind of phenomena is light?

In 16-1700th centaury they didn't know. Huygens thought light was a wave, but Newton thought light was particles. It was not until 1802 Young showed that light was a wave by noting an interference pattern when light passed two narrow slits.

But what kind of wave?

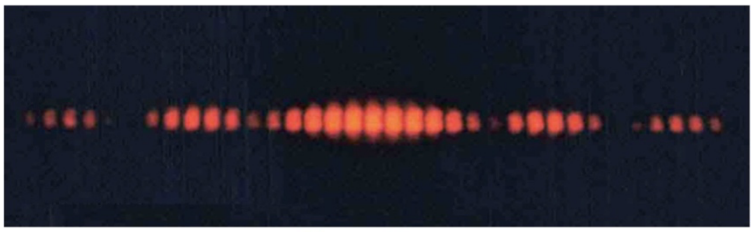


Figure 11

What is light?

Magnetism and rubber electricity were discovered 500 BC. During sailings it was registered that a compass needle was affected by a thunderbolt. And Benjamin Franklin caught a

thunderbolt with a kite and saw it charged an electroscope. So, the thunderbolt was both magnetic and electric. Then Örsted 1820 showed that electricity created magnetic force and Faraday 1832 showed that a changing magnetic field created an electrical current. And that is how we create electrical current in our power plants.

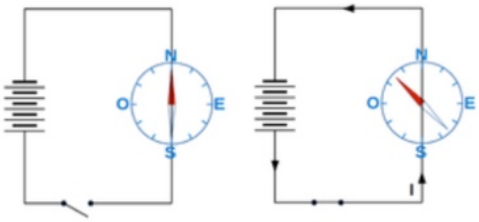


Figure 12

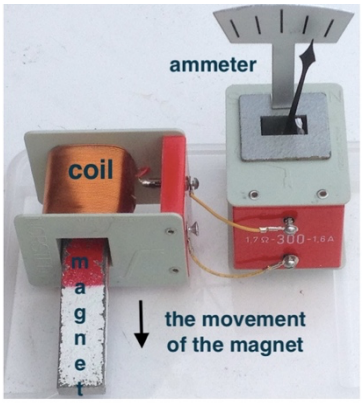


Figure 13

This and many other experiments showed that magnetism and electricity are deeply connected. This was beautifully captured in Maxwell's equations.

Solving these equations gave expressions for electric and magnetic fields like E=f(x-vt) B=g(x-vt). This is recognized as mathematical expressions for something moving in space, like waves, with velocity v. From the two constants ,which was measured in pure electrical experiments ε_0 resp. in pure magnetic experiments μ_0 ,was found a new constant $\frac{1}{\sqrt{\varepsilon_0\mu_0}}$ which =v and with the unit km/s ,that is a velocity, and a very special velocity ≈300 000 km/s, which was recognized as the velocity of light which Römer had measured in 1660-ties. So now it was clear that light is an electromagnetic wave with the velocity 300 000 km/s, which now is a fundamental constant c.

$$\nabla \cdot B = 0$$
$$\nabla \times E = -\frac{\partial B}{\partial t}$$
$$\nabla \cdot \dot{E} = \frac{\rho}{\varepsilon_0}$$
$$\nabla \times B = \mu_0 j + \varepsilon_0 \mu_0 \frac{\partial E}{\partial t}$$
Figure 14

But according to Galilee, Newton and their formulas as well as in all experience of movement velocity is relative, that is it is dependent on who measures it, from which system it is measured. E.g. when you sit still in a railway wagon your velocity relative the railway wagon is zero but your velocity relative the ground, the embankment, could be any number even very great.

But in what system does light have the velocity c? This was not clear at all. Maxwell's equations do not tell in which system they are correct. So, it was speculated that there existed some finer-grained matter called the aether, which prevailed the whole universe, as we could see distant stars, in which system Maxwell's equations were correct and in which the velocity of light was c in all directions. If the Earth was at rest in the aether the velocity of light would be the same in all directions.

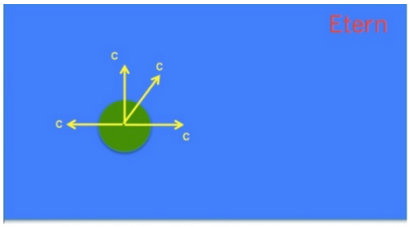


Figure 15

But the Earth is moving around the Sun so the Earth could not be at rest relative the aether all the time. Therefore, the velocity of light would be different in different directions at different times of the year.

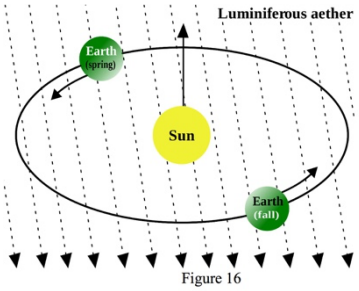


Figure 16

But all measurement always showed that the velocity of light in vacuum always was the same c. This was in sharp contradiction to all that was known about relative velocity. There were some attempts to solve this shocking contradiction, but it was Einstein's genius who gave the radical solution by saying: What is correct for all other velocities that they are relative is not correct for light. Light is very special. The velocity of light (in vacuum) is the same for all observers, is the same in all systems. **The velocity of light is absolute.**

And this has huge implication for our understanding of space and time.

What is absolute and what is relative?

If two persons from the middle of a railway wagon go in opposite direction with same velocity relative the wagon, they reach the ends of the wagon at the same time measured by a person on the wagon. And of course, according to what seems self-evident, and in accordance with that Newton declared time to be absolute, t=t', a person on the embankment seeing the train pass with high velocity v, will still see that the two persons reach the ends of the wagon at the same time. Because the person going in the opposite direction of the train's movement will have a slower velocity relative the embankment, but also a shorter way to go relative the embankment, and the opposite for the person going in the same direction as the train is moving. So, what is simultaneous in one system, the train, is, of course, simultaneous, in other systems, as that system used by the person on the embankment. Simultaneity is same for all, t=t' , simultaneity is absolute, and we have not experienced anything else. But Einstein's radical insight that the velocity of light is absolute yet shows that this is wrong.

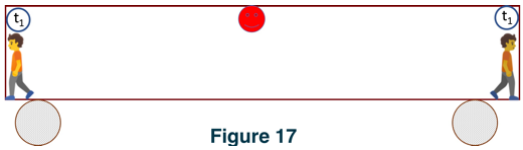


Figure 17

Figure 18

If sending light beams from the middle of the wagon it reaches the ends of the wagon at the same time for a person on the wagon. But now according to Einstein the light beam seen from a person standing on the embankment will have the same velocity relative the embankment in both direction, so the light beam going in the opposite direction than the train will reach the end of the train before the light beam in the other direction, because the distance will be shorter as it meets the movement of the wagon. The reaching the two ends of the wagon is happening at the same time t, they are simultaneous for a person on the wagon. But they are not happening at the same time t' , they are not simultaneous for a person on the embankment . So, simultaneity is relative, and time is not absolute as Newton said. But why don't we experience this?

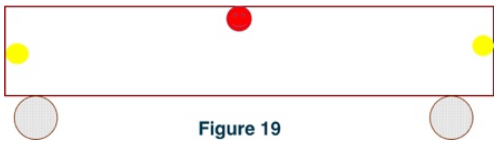


Figure 19

Figure 20

That depends on that the velocity of light is so high 300 000 km/, that is 7,5 laps around the Earth in one second.

Einstein showed that instead of Galilee- Newton's transformations what follows when velocity of light is the same for all are other transformations

Galilei-Newton	Einstein Lorentz
x=x'+vt	$x = \frac{x'+vt}{\sqrt{1-\frac{v^2}{c^2}}}$
y=y'	y=y'
z=z'	z=z'
t=t'	$t = \frac{t'+\frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$

which are more complicated. First it shows that it is not as Newton said that t=t'
but two observers measure different time for two events and that depends both on the velocity of one observer relative the other and on the distance (x) in space between the events. So, simultaneity is relative. Yet we don't, in daily life, experience that because our velocities v are so small relative c^2 so $\frac{vx}{c^2}$ and $\frac{v^2}{c^2}$ are almost zero and then Einstein's formulas , (actually called Lorentz transformations) are almost the same as Galilei-Newtons.
Einstein's formulas also show that a moving clock goes slow. But again, this effect needs high velocity to be measurable but have been proven correct in high energy physics, and with atomic clocks in fast jet planes.

But now these formulas also influence our daily life! The GPS satellites have a velocity of 14000 km/h or 4 km/s, not very fast compared to c=300 000 km/s, but fast enough that we need to correct our GPS measurements according to Einstein's formulas[11]. Because without correction there will be an accumulating error of about 12km in 24 hours making the GPS completely useless. So that the GPS works when using Einstein's formulas proves that the formulas are correct.
And as the same formulas show that simultaneity is relative this is accepted as a fact of reality.
And this leads to the reality of a four-dimensional spacetime where all that has happened still exist and also all that will happen already exist. This can be derived from the, for objective

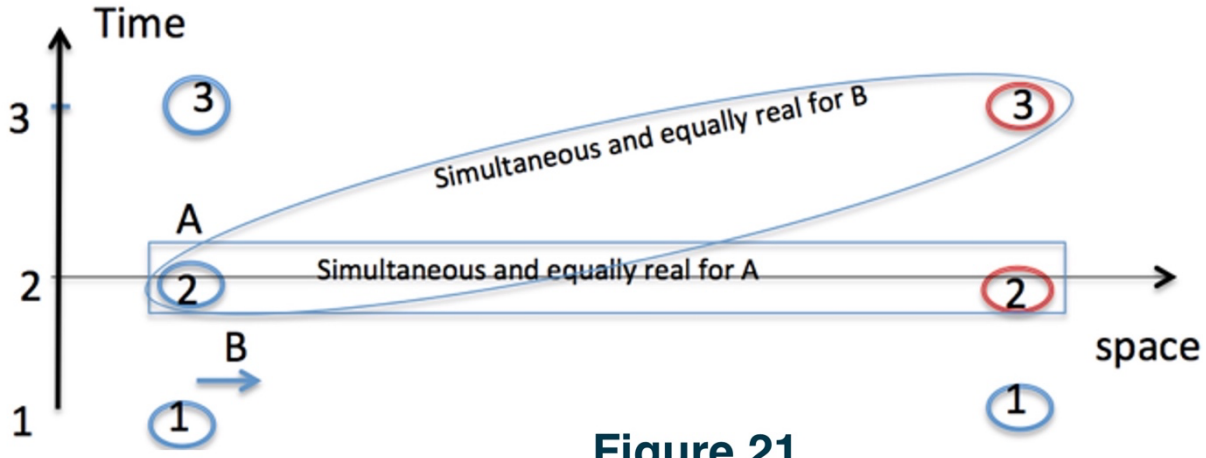


Figure 21

science basic assumption, that existence is absolute[12]. Because if for one person A two clocks at different position show 2 simultaneously for a person B moving relative A what is simultaneous with the one clock showing 2 is not 2 but 3
(depending have fast B moves)
So, what is simultaneous and equally real for A is that the two clocks both show 2 but what is simultaneous and equally real for B is that one clock show 2 and the other show 3. The

[11] You have to correct because the time goes slower due to speed, according to Einstein's special theory of relativity, but also because time passes faster according to the general theory of relativity when gravity is less at higher altitudes.

[12] This argument is questioned by some philosophers, for an overview see (Thyssen 2019). Other arguments for 4 dimensions see e.g. (Petkov, 1989, 2008, 2020). So it can be said that the question of the number of dimensions is not decided among physicists and philosophers. But I mean that NDU speaks for at least 4 dimensions or more, which provides empirical support that space time is (at least) four-dimensional as Minkowski claimed.

explanation for this relativity of simultaneity was first given by Einstein's teacher in mathematics professor Herman Minkowski [83] who argued that a clock must exist in all its history and all its future. That is a three-dimensional object exist in all its history at once. And all events exist at once. Spacetime is ontologically (at least) four-dimensional. So, all events that have happened still exist objectively in spacetime.
Thus, the claim that a species who learn to use this objective four-dimensional spacetime does not have to store memories of events in the brain, because all past events still exist in spacetime. And the same for future events they already exist in four-dimensional spacetime, which seems as leading to that future is already determined but can be solved in 6D spacetime see Appendix 2.

On illustration of spacetime.
The movement we describe in physics is a change of position when time goes. But Einstein-Minkowski showed that many of the physical and experimentally established effects in special theory of relativity can only (or better) be understood in spacetime where even time has extension as a fourth space dimension. In spacetime then there is no movement but the whole movement exits at once as a static structure. We can draw spacetime for one and two space dimensions, in a two resp three-dimensional figure.
In one and two dimensions the whole word at a certain time, at a certain point on time axel, is a line resp. a surface and can be drawn as such.

Spacetime for one-dimensional space
The movement is along x-axis from A at time t_a to B at time t_b
but exists as the whole process red line --- at once in spacetime

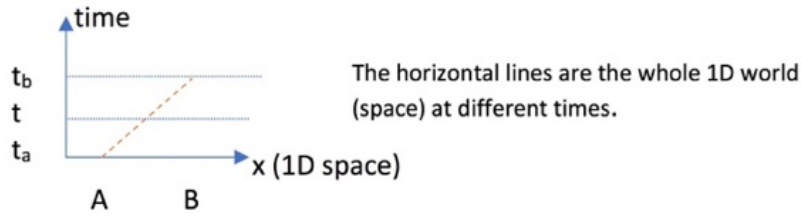


Figure 22

Spacetime for two-dimensional space
The movement is in xy-plane from A at time t_a to B at time t_b
but exists as the whole process (the red line -----) at once in spacetime

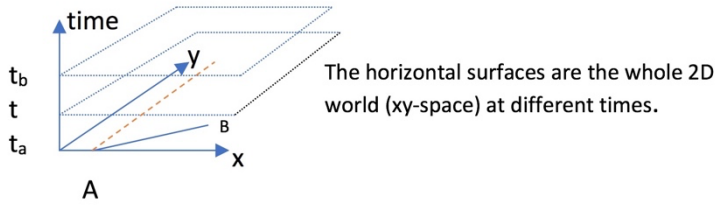


Figure 23

But we cannot draw a four-dimensional figure so for the three-dimensional space of our world we will use an illustration of the four-dimensional spacetime, where every point on time axel is the whole three-dimensional world at that time (according to one observer).
.

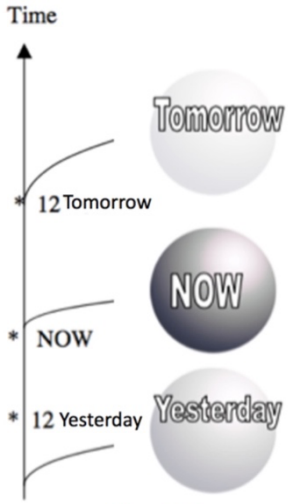


Figure 24

Appendix 2
Einstein's mistake and velocities faster than that of light.
I think most people have heard that Einstein said velocities higher than that of light is impossible, as this is without any reservation repeated and presented as an absolute dogma in science.

But how did Einstein come to this idea? I think also almost all recognize what has been called the most famous formula $E=mc^2$. This is a formula for bad, problematic and good things. Bad as it is the basis for atomic weapon. Problematic as it is also the basis for nuclear power where we still have not created secure power plants and not solved the problem of radioactive waste products. Both also for very good- it is the explanation how our Sun can produce the energy which is necessary for all life on this planet Earth.
But actually Einstein showed that the formula should be written $E = \frac{m_0 c^2}{\sqrt{1-\frac{v^2}{c^2}}}$, where m_0 is the mass when the object is at rest, as also mass is relative and increase with increasing velocity and thus the energy needed to get high velocity increase as the graph shows and from which Einstein in his seminal paper 1905 concluded
"Velocities greater than that of light…. have no possibility of existence." [84]
Very strangely it took almost 60 years until three well-reputed physicists [85] published an article 1962 in the well-reputed American Journal of Physics where they clarified that what Einstein had shown was only that it will take an infinite amount of energy to accelerate (that is start slow and increase the velocity) a material body up to the velocity of light. But acceleration is not the only means to achieve speed, which light itself amply shows. Light does not start slowly and increase its velocity but is born in a flying start with the velocity of light. Therefore, Einstein's theory cannot exclude that there are phenomena which are born with and always move with a velocity higher than that of light. This was missed by Einstein, Born, Pauli and

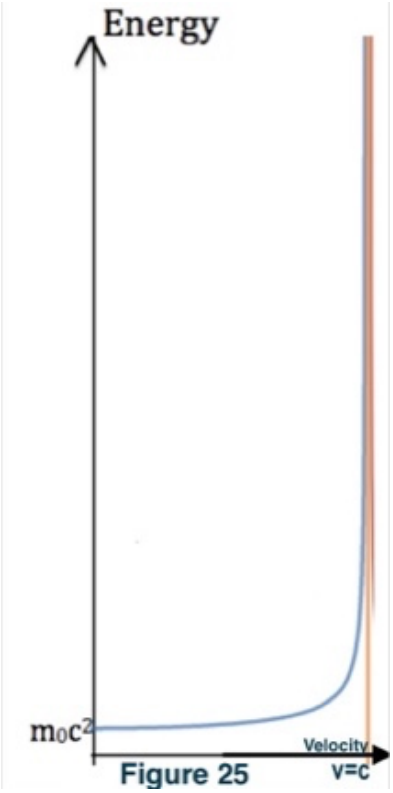


Figure 25

more. [86]. It was speculated that it could be particles faster than light and they were given the name "tachyons" from Greek "tachy" = fast. This was taken seriously and there was done experimental search for tachyons. The first started in the mid 60-ties by three Swedish physicists at the Noble Institute for Physics in Stockholm. They didn't find them but published an article about that 1968. [87]
When I as a young student in theoretical physics read that 1971 I was a bit surprised how they used Einstein's formula $E = \frac{m_0c^2}{\sqrt{1-\frac{v^2}{c^2}}}$ which was seemingly only valid for velocities less than c, because for v greater than c we get a negative number under the square root, which are good in mathematics but a bit tricky in physics. But they had a clever way to handle that mathematically:

$E = \frac{m_0c^2}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{m_0c^2}{\sqrt{(-1)(\frac{v^2}{c^2}-1)}} = \frac{m_0c^2}{\sqrt{-1}\sqrt{(\frac{v^2}{c^2}-1)}} = \frac{m_0c^2}{i\sqrt{(\frac{v^2}{c^2}-1)}}$ as $\sqrt{-1}$=i not an ordinary number but the imaginary unit in complex numbers. But as this is a bit tricky in physics, they correctly argued, that these tachyons can never go slower than the velocity of light so they can never be at rest relative our system so we can never weigh them thus never measure their mass at rest m_0. So they argued, the rest mass of tachyon could very well be an imaginary number so $m_0=i\mu_0$ where μ_0 is an ordinary real valued number. So, they got $E = \frac{m_0c^2}{i\sqrt{(\frac{v^2}{c^2}-1)}} = \frac{i\mu_0c^2}{i\sqrt{(\frac{v^2}{c^2}-1)}} = \frac{\mu_0c^2}{\sqrt{(\frac{v^2}{c^2}-1)}}$ which is a measurable quantity.

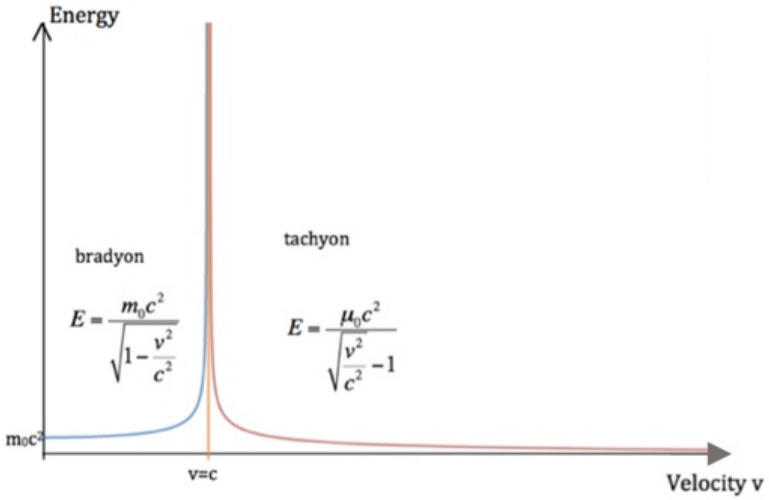


Figure 26

Figure 26
Possible but perhaps a little ad hoc. So more in the spirit of Einstein's theory of relativity where one postulate was that all systems having a constant velocity relative an ordinary system (an inertial system) was equally good, I thought that a bunch of tachyons moving with the same relative velocity relative an ordinary system would also be a valid system. Because at start there was no speed limit for the good systems.

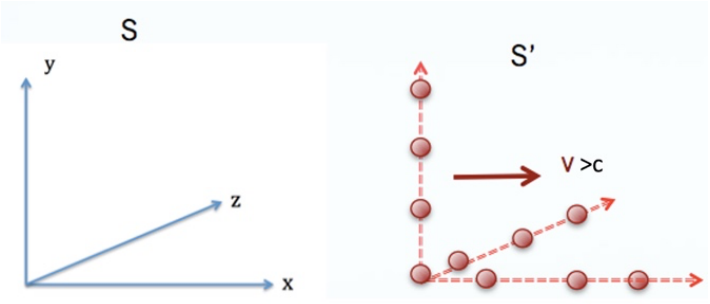


Figure 27

v greater than c.

So, I wanted to find a transformation between our ordinary systems and systems moving faster than light. Fortunately, at that time my textbook was Rindler's *Special relativity*.[88] When he derived Einstein's formulas (the Lorentz transformations) he started with Einstein's two postulates:
All inertial systems are equally good for formulating the laws of physics

The velocity of light in vacuum is absolute, the same in all systems

and from that derived for the transformation between two systems where S' moves with the velocity v in S this mathematical expression

$x^2 + y^2 + z^2 - c^2t^2 = \pm (x'^2 + y'^2 + z'^2 - c^2t'^2)$

Rindler correctly argued that for velocities going to zero there must be +. And so, he discarded the – sign. But as I was looking for transformations with velocities greater than c, I tried the minus sign, at first with the usual simplification with just one space dimension x and time t and got

$x^2 - c^2t^2 = \pm (x'^2 - c^2t'^2)$. And now simple gymnasium calculation[13] showed that + sign gave Einstein's formulas

$$x = \frac{x'+vt}{\sqrt{1-\frac{v^2}{c^2}}} \qquad t = \frac{t'+\frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$$ valid only for velocity less than the velocity of light c

but − sign gave

$$x = \frac{x'+vt}{\sqrt{\frac{v^2}{c^2}-1}} \quad t = \frac{t'+\frac{vx}{c^2}}{\sqrt{\frac{v^2}{c^2}-1}}$$ valid only for velocities greater than the velocity of light c.

From Einstein's postulates and simple calculations, one gets formulas describing ordinary matter with velocities less than the velocity of light, and we have light and now also formulas describing something going faster than the velocity of light, a world beyond light? Whatever that was. I can assure you that this discovery shook my then conviction that the scientific materialistic worldview was self-evident.

But this was not enough. As our real world has three space dimensions length, breadth and height we must use (x, y, z) and thus the full expression Rindler got

$$x^2 + y^2 + z^2 - c^2t^2 = \pm(x'^2 + y'^2 + z'^2 - c^2t'^2)$$

But I knew a proof in mathematics [89], which said that using the minus sign here again gave this
imaginary numbers, which are tricky. But the proof also showed that the minus could be used with ordinary numbers if we had six dimensions three space (x, y, z) and three time dimensions (t_1 , t_2 , t_3) like this

$$x^2 + y^2 + z^2 - c^2t_1^2 - c^2t_2^2 - c^2t_3^2 = \pm(x'^2 + y'^2 + z'^2 - c^2t'^2_1 - c^2t'^2_2 - c^2t'^2_3)$$

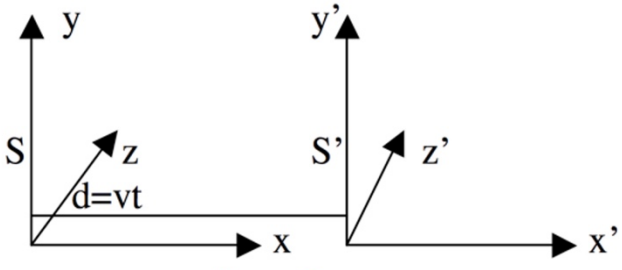


Figure 28

Of course, at that time I had no idea what these extra dimensions could be.

[13] It can be shown that the transformation are linear so x'=B(x-vt) according to fig 28 t'= Fx+Gt

Appendix 3

Ghosts in Flatland are eternal beings in and our world.

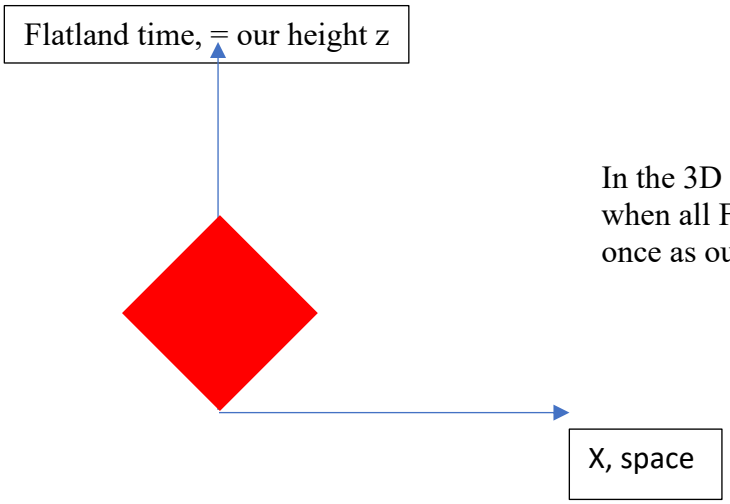
If in Flatland the flat red ghost with width w and by Flatlanders seen as a line which suddenly appears at x=0 and grows to all x in (-10,10) when Flatland time increase from 0 to 10 and shrink to x=0 and disappear when Flatland time t increase from 10 to 20
it can mathematically be written

$$ghost = \{red\ at\ the\ points\ (x,y); 0 \le y \le w\ and - t \le x \le t\ \ when\ t\ 0 \rightarrow 10\ and\ t - 20 \le x \le 20 - t\ when\ t\ 10\ \rightarrow 20\}$$

In Flat-Einstein and Flat-Minkowski's 3D spacetime where Flatland time is seen as a third space dimension the whole growth and shrinking process of the ghost can be seen as one static figure

Ghost= {red at the points (x, y, z); 0≤y≤w, -z ≤ x ≤ z all z ; 0≤z≤10 and z-20≤x≤20-z all z ;10≤z≤20}

This we, but not Flatlanders can illustrate in three dimensions, using our height for Flatland time (the width is here suppressed, width y is perpendicular to the plane of the paper)



In the 3D spacetime nothing can move
when all Flatland time moments exist simultaneously at once as our height z.

But Flat-Moody didn't only experience the 3D ghost but also how it moved and gave the impression of suddenly appearing growing, shrinking and disappearing flat ghost in 2D Flatland.
Flat-Moody experienced our world with three space dimensions but also our fourth dimension, our time T in the movement. He could describe his experience mathematically

$$Ghost = \{red\ at\ the\ points\ (x,y,z); 0 \le y \le w\ and - (z+T) \le x \le (z+T)\ \ all\ z\ ; 0 \le z+T \le 10\ when\ T\ 0 \rightarrow 10\ and\ (z+T) - 20 \le x \le 20 - (z+T)\ \ all\ z\ ; 10 \le z+T \le 20\ when\ T\ 10\ \rightarrow 20\}$$

When this 3D ghost passed through Flatland which in our system is characterized with z=0 the experience in Flatland is

$$Ghost = \{red\ at\ the\ points\ (x, y, 0); 0 \leq y \leq w\ and - (0 + T) \leq x \leq (0 + T)\ \ \sout{all\ z}\ ; 0 \leq 0 + T \leq 10\ when\ T\ 0 \rightarrow 10\ and\ (0 + T) - 20 \leq x \leq 20 - (0 + T) \sout{all\ z}\ \ 10 \leq 0 + T \leq 20\ when\ T\ 10\ \rightarrow 20\}$$

That is (eliminating the unnecessary 0:s and z as no height or z coordinate exist in Flatland

$$\{Ghost = red\ at\ the\ points\ (x, y); 0 \leq y \leq w\ and - T \leq x \leq T\ ;\ when\ T\ 0 \rightarrow 10\ and\ T - 20 \leq x \leq 20 - T\text{-}\ \ when\ T\ 10\ \rightarrow 20\}$$

which is exactly the description of the flat ghost in Flatland, only using our time T instead of Flatland time t (here the deep problem of time shows up).
Even if at that time neither Flat-Einstein nor Flat-Minkowski had had a sensory experience of three or four dimensions they immediately realized that Flat-Moody's experience was real and a better scientific explanation of the Flatland ghost than coming from nowhere. And they also so it as confirmation of the existence not only of their 3D spacetime but also of an extra time dimension which seemingly solved the old problem with the absence of flowtime in 3D spacetime.

Appendix 4

A heuristic reasoning about the possibility for consciousness to survive death.
If the mathematical conjecture
An N-dimensional structure can in no way create, produce, give, "emerge" an (N + 1) - dimensional structure.
is true a 4D brain cannot by itself create any structure with five or more dimensions.
So if such structures exist, which I argue NDE show to be the case, these structures must has its ground in a spacetime with five or more dimensions.
Yet this conjecture only shows that the 4D brain is not sufficient.
It does not directly show that the brain is not necessary.
But even if the brain creates some part of the 5D structure it will be a small part of that as the brain at most, if the conjecture is true can create a 4D structure.

Say that a 5D experience E_5 has two parts one from 5D spacetime and one from 4D brain

$$ST_5\ \ resp. B_4$$

think we can describe this as

$$E_5 = ST_5\ \cup B_4 = \{(x_1, x_2, x_3, x_4, x_5) \in ST_5\ \vee (x_1, x_2, x_3, x_4\ ) \in\ \ B_4\}$$

But B_4 is just a 4D "surface" in 5D and is just very small in 5D
so can probably not change the 5D experience much if the brain and B_4 disintegrates and thus, that the major part of $E_5 = ST_5$ still will exist.

NOTES (internet links worked 210819)

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45. Much later I came back to this research on six dimensional spacetime, and have presented some basic results in a conference paper Pilotti, J. (2020), with this abstract:
    "The history and rationale for the discovery of superluminal Lorentz transformations is given. The analyses of how Einstein, Minkowski, Cunningham, Born, Pauli and three more didn't find the possibility of v > c, at least show that we must be cautious in our interpretation of the principle of relativity and symmetry and how we mathematically describe "rotation" in the non-Euclidean Minkowski spacetime, not to implicitly exclude v > c. It is also shown how Minkowski already 1908 could have discovered a six-dimensional spacetime, with three space and three "timelike" dimensions, which allows superluminal LT. Is this just a mathematical possibility? Or can it be related to the apparently insurmountable contradictions, between block universe in the theory of relativity and our everyday experience of change and the flow of time, and between determinism and indeterminism in relativity vs. quantum theory and to the relation between consciousness and physical reality? "
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53. The physicist and philosopher Vesselin Petkov writes
    ". . . - that the flow of time is mind-dependent – outlined by Weyl should have been examined more rigorously. [...] At first glance this idea appears to be self-contradictory since Weyl assumed that consciousness (leaving aside the question of what consciousness itself is) *moves* in Minkowski spacetime where no motion is possible. [Petkov, V. (2005) p. 150 italics in orig.] " and
    "But when we want to understand how we can have the feeling that time flows in the Minkowski four-dimensional world, it appears that Weyl's proposal holds the greatest promise for the resolution of the apparently insurmountable contradiction between the physical theory of relativity (and the experiments that support it) and our everyday experience. Moreover, so far, no one has found a way, which does not involve our

consciousness, to reconcile the spacetime world view and the fact that whatever we perceive happens only at the present moment. [Petkov, V. (2013) pp. 110-11]

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