Isomorphic Concepts for Uncertainty Between Consciousness and Some Interpretations of Quantum Mechanics

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Abstract

Quantum mechanics based on uncertainty measurements are generally thought to be associated with weird conceptions, not conceivable in the macrocosm. Nevertheless, quantum mechanics and consciousness seem to have some isomorphism. At the first person viewpoint the present and the recent past can be considered as observable reality in consciousness, which is associated to certainty, the far distant past and future can only be considered as potentiality, linked to increasing uncertainty. Similar to quantum mechanics, uncertainty represents a major component in consciousness, which has to be controlled for allowing predictions with probability. There is a general rational principle consisting of superposition with probability and applicable to physics, biology and psychology, which allows prediction, if precise information is unavailable. This principle seems to show isomorphism between quantum mechanics and consciousness.

Key Words: isomorphism, quantum mechanics, consciousness, uncertainty, probability, superposition, non-locality, timelessness

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Introduction

The wave function of quantum mechanics (Schrödinger, 1926) is known for more than 80 years to predict the behaviour of elementary particles in the atomocosm with high probability. The wave function is based on a mixture of several, sometimes opposite physical states in superposition together with their probability amplitudes. But at the moment of a measurement in each particular experiment, only one of the multiple superposed physical states is really observed. How did the choice occur, what was the cause of the selection? Heisenberg (1927) describing the uncertainty principle showed that location and velocity of elementary particles couldn't be determined with precision for the same time period. Superposition of physical states with their respective probability estimation seemed to overcome the problem of the uncertainty situation. But Heisenberg estimated that the state vector reduction leading to only one observed physical state is not "the choice of nature" but the "choice of the observer" (Bitbol, 2008). Here the observer is considered as a human observer not only an entity interacting with measurements. Vimal (2008) showed a direct link between conscious subjective experiences and quantum mechanics by introducing proto-experiences composed of all subjective experiences in superposed form in elementary particles. Physicists like von Neumann (1970), Wigner (1979) and Stapp

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(2007) evoked an implication of the human consciousness in different ways. Thus from the beginning quantum mechanics were thought to have a special linkage to human consciousness. Schrödinger (1935) estimated in a thought experiment that superposition in the wave function would in the macrocosm correspond to a simultaneously living and dead cat, which seems not to be conceivable with human consciousness. Including other weird conceptions besides superposition such as uncertainty, probability, non-locality, timelessness and entanglement, quantum mechanics seemed to represent a particular situation of the atomocosm, totally different from the one found in the macrocosm.

Nevertheless, in human consciousness certain functions were found to be isomorphic to conceptions in quantum mechanics, also showing uncertainty and superposition with probability estimations (Jansen, 2008). Could the conception for the control of uncertainty be isomorphic in quantum mechanics and consciousness (Jansen, 2010a; 2010b)? If consciousness is only considered at the first person level (Chalmers, 1995), which is completely different from the third person level, but inseparably correlated with first person perspective in dual-aspect monism framework (Vimal, 2008), there is the awareness of the present, the past and the future. Whereas the present can be observed as reality with the help of all human perception organs, the past and the future can no longer be directly observed and are either reconstitutions or predictions. They are represented in the human mental state, where consciousness is thought to reside, by re-associated memorised perceptions. Whereas the present and the recent past can be perceived with certainty, the representation of a far distant past can only be perceived with uncertainty, i.e. the cultures of ancient Egyptians. All what can happen in the future is in any case associated to uncertainty, since it may or may not happen. Uncertainty was described by Heisenberg (1927) for quantum mechanics, but its general principle is also a dominating feature in human consciousness, especially for a distant past or an expected future. Therefore the control of uncertainty in consciousness seems to show conceptions isomorphic to those appearing in some interpretations of quantum mechanics.

Observation of reality in consciousness and physics

Observation of reality is the essential starting point for physics as well as for consciousness. Observation is considered as the ability to discriminate stimuli and to report information on reality, the 'easy problem' (Chalmers, 2003). There are three types of realities: conventional mind-dependent reality (CMDR), ultimate (*samadhi state*) mind-dependent reality (UMDR) and mind-independent reality (MIR) (Vimal, 2009 a); here CMDR is considered. It constitutes a complex phenomenon in consciousness, since it appears as a tri-specific perception, in terms of present, past and future, including active perception of the present linked to predictive perception of the future, which is itself based on memorised perception of the past.[2] The three perceptions form a unit and are necessary for an individual to conduct conscious actions. They have to respect the present, but should also be adapted to an expected future, which is based on memorised perceptions of the past. Although perception with all perception organs in full activity may correctly represent reality in the present, spontaneously associated predictions of the future could be wrong. For instance, an active visual perception of a statue might give the appearance of bronze, which is associated to the future perception of a very heavy material when picked up. But an identical visual appearance can be obtained after special treatments of a statue of polystyrene, an extremely light material. In both cases the active visual perception is identical, but can be associated to two different predictive perceptions concerning the weight of the statue. Without new perceptions by picking up the statue again, the different weight could not be perceived. This shows that the active visual perception representing only one aspect of the statue is spontaneously complemented by a predictive perception or interpretation based on memorised past perceptions. In general memory perception corresponds to normally

[2] For phenomenal time and its biological correlates, see (Vimal, 2009b).

expected situations similar to the default proposition of a computer system. But sometimes the expected future perception is far removed from reality, thus the associated memory perception has to be verified by new perceptions. Therefore only verification of the tri-specific perception, which includes observation and interpretation, renders the mental representation of the statue reliable.

If perception was limited to the present only, it would be insufficient for directing any meaningful action, which has to be adapted to future conditions and must be guided by previsions build up with memorised past perceptions. Conducting a car in town necessarily depends on perception of the car behaviour in the present, but simultaneously necessitates prevision of future actions, for instance when seeing crossing roads or traffic signals. Perception of the present is limited to perception organs in full activity, whereas perception of the future is imagined prevision with the help of already memorised perceptions. Active and memorised perceptions are clearly distinguishable by different associated feelings, which are much more acute for active perception and faint for memorised perception. The instant feeling of getting burned by a hot material is terribly more intense than the reminiscence of the burn a day later. Whereas the intense feeling during burning cannot be modified, the faint reminiscence of the burn in consciousness can be modified by forgetting or recalling it again. Therefore the great intensity of heat perception by an organ in full activity directly shows reality in the present, whereas the faint reminiscence of the same event a day later is only a memorised perception experienced in the past. Since prevision of the future is based on memorised perceptions, it is also felt as faint and modifiable.

Sometimes a feeling of hard reality or reality shock can be experienced in consciousness and is entirely due to the tri-specific present/past/future perceptions. If the expected future is identical to the perceived present, there is no feeling of hard reality. But if the expected future is totally different from the occurring present, an intense feeling of reality induces the reality shock, which is the consequence of an important discrepancy between the faint expected future perception and the intense actual perceptions through activated perception organs. When the tri-specific perception is not aware of an obstacle on the way, one's foot might hurt the obstacle and perceive violent pain through activated pain sense organs, indicating that imagined predicted reality did not correspond to actually perceived reality. The reality shock clearly indicates that perception has two different levels, a representation perception for the prevision of events in the future based on faint, modifiable, memorised perception of the past, which can, however, be false. It is opposed to reality perception in the present based on intense, non-modifiable perception induced by perception organs in full activity.

Physical formalism seems at the first glance to correspond to observable reality, since it is based on observation of reality in the present and the recent past. A mathematical representation of reality when limited to the present and the recent past induces a feeling of certainty, since it corresponds to observable reality, however, if the mathematical formula is extrapolated into the far future, the correspondence between expected and realised events becomes uncertain and has to be verified by new measurements in the future. This situation seems to be isomorphic to perceptions in consciousness, when an expected perception is verified by new active perceptions, it appears as certain, but if it remains only associated to memorised perceptions from the past it becomes uncertain. The verification between prediction of future events and their correspondence to reality requires new active perceptions for consciousness and new measurements for physics. Therefore extrapolation in the future always needs verification, a situation that seems to be isomorphic between consciousness in the above defined sense and physical formalism.

Uncertainty in consciousness induced by perceptions of the past and the future

The perception of the environment requires all main perception organs, which induce space and time. The colours red and green can be observed by the visual system via the eye, but they are separated from each other

in space for instance on the page of a book or in time as in traffic lights. Dual awareness of colour, in this example, is therefore linked to space-time. Whereas all perception organs allow the observation of the spacious present (Vimal, 2008), the past is no longer observable and has to be reconstructed with the help of previously observed and memorised perceptions. Therefore the past can no longer represent the actual present with certainty, since it may have changed in the meanwhile. Uncertainties may also be mind dependent, such as irregularities of the personal memory (Vimal, 2010). The past is not limited to personally memorised perceptions, but has to share the whole knowledge of a society, thereby depending on oral or written transmission of knowledge, such as those from cultures like Ancient Egypt.

The future can be predicted by consciousness with the help of observed perceptions in the present associated to memorised perceptions of the past. If present and past perceptions show a great regularity like sunrise and sunset, the future can be predicted with high probability, whereas mind independent (Vimal, 2010) irregular present and past like climate conditions induce low probability with great uncertainty for the evaluation of the future. In consciousness the future as well as a far distant past are always confronted to uncertainty, since expected events could or could not occur and represent potentiality instead of reality. Potentiality becomes more uncertain, if different projected future events are to be envisaged for the same time period, but depend on climate conditions. They are then in a sort of superposition similar to quantum mechanics. Uncertainty is derived from incomplete perception of the present, past and future and is therefore a normal phenomenon in consciousness. There might be a certain isomorphism to uncertainty found in quantum mechanics.

Uncertainty in physical formalism also dependent on the past and the future

Past, present and future are necessarily included in all physical formalisms, but at a higher integrated information level. Classical as well as quantum mechanical formalism, was constructed on observation of the behaviour of physical objects in the present, which can be measured. Before the measurement an abstraction process is needed, dissecting physical objects into different aspects, some of which may become measurable. A statue in bronze on a public place may be considered under different aspects such as colour, weight, temperature, spatiotemporal coordinates and many others. Although some aspects are measurable, others are not, such as the symbolism or the art value of the statue. Measurable aspects can be observed and treated with mathematical formalism. Dynamic events like the planet movements around the sun show measurable evolution with space-time coordinates. Their traces can be visualised in ellipses, which represent a summary of constellations observed in the present and complemented by memorised observations in the past. Since the evolution of planets is invariant in time, predictions can be made from the past and the present to the future and are considered as physical laws. Thus similar to consciousness, physical formalism is based on observable reality in the present and the recent past, but complemented with unobservable potentiality for the distant past and the whole future. Consequently even in physical formalism the observable reality is associated with certainty and the future potentiality with uncertainty, since it may or may not happen.

Physical laws are established with mathematical formalism representing a higher order of integrated information, which incorporates behaviour of the past, the present and the future in the same formula, for instance in the ellipses for the planet revolutions around the sun. Due to the inclusion of the past and the future, the physical formula is no longer observable as a whole, since the human eye can only observe the planet constellations of the present. Therefore the higher order information of physical formalism containing simultaneously present, past and future becomes unobservable. The higher integration of information represents the main difference between consciousness and physical formalism. Although the high integration is intellectually conceivable, it largely exceeds observable reality in the present.

Moreover, mathematical formalism can be extrapolated into the past and the future in an unlimited manner, thereby increasing potentiality with uncertainty. Thus unlimited extrapolation of mathematical formalism as a higher order information largely exceeds observable reality and includes potentiality with high uncertainty. For instance, the laws of Kepler in classical physics showed invariance of the revolution of the planets around the sun in form of ellipses. Up to now the predictions of this law established in the past were proven, but prediction into an unlimited future becomes highly uncertain. It is expected that the sun will explode as a supernova within some billion years, which will necessarily change the prediction of Kepler's law for the revolution of the planets. Therefore physical laws can only determine reality with certainty for the present, the recent past and a limited future. When classical physical formalism allows extrapolation into unlimited future, it has to be considered as potentiality with high uncertainty, which appears isomorphic to uncertainty for the future in consciousness.

In quantum physics already all observations in the present start with uncertainty measurements. In the wave function this problem seems to be circumvented by the concept of superposition of multiple physical states with different probabilities, each of which represents one classical physical state. Similar to classical physics, the wave function includes the past, the present and the future of physical states and thereby includes potentiality with uncertainty, especially for the far future. Additionally quantum mechanics reaches an even higher order information level than classical physics due to superposition of multiple physical states, which are even less observable than classical physical formalism. Nevertheless, according to the initial interpretation of Bohr (Kiefer, 2002) measurements indicate observable reality in the present, thus all superpositions have to collapse to only one. In classical physics, the observation of planet constellations also induces the collapse of past and future constellations, which are included in the same formalism, since only one constellation, the one of the present, can really be observed. Therefore collapse is required in classical physics as well as in quantum physics according to the Copenhagen Interpretation, when any prediction of a higher integrated formalism has to be verified by observation in the present. Uncertainty in physics is present in classical formalism by unlimited extrapolation and in the Copenhagen Interpretation of quantum mechanics by the uncertainty principle and superposition of physical states. Their control seems to use similar concepts in quantum mechanics and consciousness with the help of superposition, probability, non-locality and timelessness. Other interpretations of quantum mechanics overcome uncertainties in a different way. Everett's *multivers* theory supposes that superposition corresponds to multiple parallel universes, which allow the passage from one to the other, so that collapse is no longer necessary. In de Broglie-Bohm's theory particles have always positions and are guided by the wave function. Uncertainty of the measurement problem is resolved, since particles have definite positions at all times.

Superposition and probability in consciousness

Future events are unobservable reality, but can be imagined in the mental states as potentiality, which means that they may or may not occur. Thereby the certainty of direct observations in the present is replaced by uncertainty for potentiality in the future. Uncertainty can be controlled in consciousness by considering several alternatives for the same space-time, thus they are imagined in a sort of superposition. Consciousness allows to project different projects into the future, for example a car driver can during driving imagine several actions for the moment when he arrives at destination, such as urgent phone calls or relaxing tee time discussions. Future actions are only potential, which signifies that they may change as long as they are not yet realised. Therefore any projection in the future includes at least the opposite alternative, which means its non-realisation. Therefore potential alternatives have to collapse to only one, which is the one to become realised. According to certain Copenhagen interpretations quantum mechanics makes a similar distinction in the

wave function between multiple physical states in superposition and their collapse during the measurement process, when they become observable reality.

Superposition in consciousness is necessarily accompanied by probability estimations, which help to get a more precise appreciation of the future. Regular events like sunrise and sunset can be predicted with very high probability for the future, whereas irregular situations induce much lower probability evaluations. When a car driver has to reach a place in town during the rush hour at a precise time, he will constantly compare the direct route to other routes for the best probability to get there in time. Probability is complementary to potentiality and allows a better evaluation of different superpositions. Since the future is uncertain, consciousness allows predicting possible future situations with different probabilities. Thereby observation makes the essential distinction between reality in the present and potentiality in the future, since reality is observable, whereas future remains unobservable.

Non-locality and timelessness in consciousness

Every projection into the future is only potentiality and thereby subjected to the uncertainty "to be or not to be realised". Therefore any precise location of events projected by consciousness in the future is not reality but potentiality and must consequently be considered as partially non-local with respect to reality situations. This seems to be isomorphic to quantum mechanics, since elementary particles seem not to show precise, only probable locations and cannot possess trajectories (Zeh, 2009), as they would have in classical physics, with the exception of the de Broglie-Bohm theory. Without any trajectory precise location of elementary particles becomes unconceivable in quantum mechanics. Uncertainty leads to the conception of non-locality, for any prediction by human consciousness as well as quantum mechanics, which is another kind of isomorphism. In consciousness non-locality becomes much more impressive, when no precise location can be predicted as for an airplane lost somewhere over the ocean. As long as the airplane cannot be localised precisely, it leaves a feeling of non-locality within the whole area of its supposed trajectory, which can only be calculated with probabilities.

When Consciousness predicts future time periods, this also leads to an impression of timelessness (Jansen, 2011). For the same reason as for location, different events in superposition for a future time period render the time scale uncertain, since the event "may or may not happen". The event is considered as if it is outside a precise time scale. Therefore future events remaining only potential induce a feeling of partial timelessness in consciousness. Similar to location, time also seems to disappear in consciousness when there are no precise time limits and time becomes phenomenal time with an experienced duration (Vimal, 2009b)

All laws of physical or societal nature indicate an invariant behaviour, which is a constant behaviour without any time limit. The planets of the solar system revolve invariantly in form of ellipses around the sun, thus suggesting timeless behaviour. Here are two different aspects of the same events, on the one hand movements consuming time and on the other hand constancy of behaviour as if time had disappeared. But without underlying movements the timeless behaviour could not exist, thus timeless behaviour still includes the notion of time, but in an unobservable form.

In the formalism of classical physics, time seems to disappear for the comparison of traces of movements of planets. Grouping of individual movements in traces represents a higher order information level, which hides underlying movements and thereby time. But the human observation is limited to only one single point of the ellipses of the planet movements, whereas simultaneous observation of the entire ellipse as represented by the physical formalism is impossible. Therefore timelessness is due to integration at a higher order information level, which includes past, present and future. Nevertheless, time is necessarily included but in a hidden form within physical formalism of planet movements. Disappearance of time may be similar in quantum mechanics, which also includes behaviour of elementary particles of the past, the present and the future in the wave

function and thereby represents a higher integrated but now unobservable information level.

Discussion and Conclusion

Quantum mechanics were often shown to have a relation with consciousness, especially due to the collapse of superposition of physical states during the measurement (Bitbol, 2008). Heisenberg seemed to favour the idea that the observer had to make a choice (Bacciagaluppi, 2009). Von Neumann (1970) commented "It was not possible to formulate the laws (of quantum theory) in a fully consistent way without reference to consciousness." Wigner (1979) introduced a central role of consciousness for the state vector reduction. Vimal (2008 - 2010) proposed a pan-protopsychist model, in which proto-subjective experiences consisting of all fundamental subjective experiences of consciousness (SEs) are superposed at the fundamental level to all physical elements, down to elementary particles and strings. Therefore quantum mechanics seemed to be implicated with consciousness.[3] Quantum mechanics were also found to show partial isomorphism with consciousness (Jansen, 2008; 2010b) and to hide time in physical formalism by its integration at a higher information level, leading to apparent timelessness (Jansen, 2011).

When examining consciousness, but only at the first person level, it became clear that uncertainty plays an important role as it does in quantum mechanics. This is essentially due to incomplete information in consciousness concerning the past, the present and the future. Here it is essentially tried to compare these notions of time with their accompanying uncertainty between consciousness as it is experienced at the first person level and the general physical formalism. Whereas the present represents the only observable reality, the past is based on memorised perception of a previous present and the future is only uncertain potentiality, not reality. Accordingly certainty and uncertainty may change considerably, for instance in the present when all information is observable, reality is associated to certainty, but in situations with lacking information potentiality leads to dominating uncertainty. The concept of the present is limited to the first person level and excludes the third person level, which was experienced in Libet's experiments, where the present could be measured to about half a second. Here the present is represented by one unit of action, like the lecture of an article, but not each word as one time unit.

The recent past constituted by memorised observations also seems to be associated to certainty, although the far distant past is necessarily represented with potentiality and uncertainty. The future is an extrapolation of present and past observations. The near future may appear more certain, if observations in the present and the past show great regularity, like sunrise and sunset, but in the case of irregular observations, like the weather conditions, even the nearest future becomes uncertain? However, the far distant future in billions of years will always be expected with a great deal of uncertainty, even if the situation in the present appears regular. Uncertainty, the opposite of certainty, remains a major component in consciousness and only varies in its degrees by showing a minimum in the present and a maximum for the far distant past and future.

The presence of uncertainty in consciousness suggests that human evolution might have developed specific functions for the control of uncertainty, which could be isomorphic to some interpretations in quantum mechanics. Indeed it could be found that in all situations with uncertainty consciousness uses superposition of multiple potentialities for the same time period, which necessarily required probability estimations to establish a rank order for the evaluation of individual events. When information on spatiotemporal coordinates was lacking, the notion of non-locality and timelessness appeared in consciousness. Physicists considered these functions initially as weird factors, which could only be found in quantum mechanics. Schrödinger (1935) considered them in his famous "cat thought experiment" as special conditions only found in the atomocosm, which differentiated the atomocosm from the macrocosm.

[3] For quantum physics and consciousness see also (Vimal, 2010).

The measurement problem of quantum mechanics still finds different interpretations. The initial interpretation by Bohr seems to avoid any explication of the behaviour of elementary particles before the measurement process. According to the Copenhagen Interpretation of Heisenberg's uncertainty principle the wave function including multiple physical states has to collapse to only one during the measurement process. More recent physicists (Everett, 1957; Lockwood, 1996; Deutsch, 1997; Zeh, 2009) suggest that the superposition of the wave function is an existential reality, and that we are living simultaneously in "a vast number of branching parallel universes" (Deutsch, 1997), which are called *multiverse*. Due to their existential reality superpositions cannot collapse, there is only passage from one to another superposition, which overcomes the uncertainty problem. De Broghlie-Bohm's theory or pilot wave theory is another interpretation of the quantum theory introducing hidden variables. Uncertainty of the measurement problem is resolved, since particles have definite positions at all times.

Isomorphism with consciousness can only be established when considering the Copenhagen Interpretation (Kiefer, 2002), which postulates the collapse of all superpositions to only one during the measurement process. In consciousness uncertainty also led to multiple superpositions, called potentialities, which had to collapse to only one and only thereafter became observable reality. Isomorphism between quantum mechanics and consciousness, as reported here, only concerns the general conceptions, such as uncertainty, probability, superposition, non-locality and timelessness. Nevertheless, all results obtained with these general conceptions by quantum mechanics, for instance the violation of the Bell's inequalities by non-local interaction, are not included in the described isomorphism.

Uncertainty in physics is not only limited to quantum mechanics, but also found in classical physical formalism, since mathematically formulated physical laws can be extrapolated to infinity. Although they are based on reality, which is observable in the present and the recent past, they allow extrapolation to unlimited past and unlimited future. Unlimited extrapolation can no longer be considered with certainty but becomes potentiality linked to a high degree of uncertainty. Classical physical formalism also includes all space-time combinations of the present, the past and the future and has therefore to collapse to only one, if a measurement is performed in the present. Thereby collapse is not only limited to quantum mechanics but seems to be a general phenomenon of physical formalism due to the concentration of information at higher information levels, which largely exceed observable reality. When physical laws have to be verified for their correspondence to observable reality, the highly concentrated information level has to be reduced to a much simpler information level and only then becomes observable again in the present.

In consciousness observation showed the problem that it is in general spontaneously associated to interpretation based on memorised perceptions in the past, which may not necessarily correspond to actual perceptions in the present. If there is a discrepancy between memory perceptions confronted to new perceptions, there is the experience of the reality shock, which clearly shows that imagined reality in the mental states does not always correspond to observed reality in the present. Therefore perception is only a representation of reality in the mental states and can be true or false. Thus verification by new perceptions becomes essential to prove, if the representation corresponds indeed to reality. Interpretation based on memorised perception of the past has to be confirmed by new information in the present. In general physical formalism is thought to be in good correspondence to reality for the present, the recent past and the near future. But all extrapolation to a far distant past or future has necessarily to be verified again, to confirm the expected correlation with reality even in physical formalism.

Isomorphism found between consciousness and quantum mechanics for the control of uncertainty might allow a better understanding of some of the general conceptions in quantum mechanics, which were at the first glance interpreted as weird conceptions for the macrocosm.

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