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Free Will Theorems in Nonlocal Information Transfer without Nonlocal Communication

How could an experimenter agent be in possession of ‘free will’ in a deterministic world? Central to the plausibility of ontological, realistic quantum mechanics is the question of the free choice of an experimenter. Specifically, how does the agent evade pre-determination by the past history of the universe? Equally central is the following question: Why is the known violation of setting or parameter independence in deterministic theories, such as de Broglie-Bohm theory, not in conflict with special relativity and the non-signalling theorem? This presentation reconsiders deep links between these questions and offers possible answers based on the concept of ‘emergence’. The chief characteristic of emergence, self-organization, or complexity, theory is its account of the appearance of novel, unpredictable outcomes – whether physical, biological, or psychological in nature – based upon entirely deterministic relations (e.g., Walleczek, 2000).
The first part of this presentation reviews recent work which (i) countered the notion that axiomatic non-signalling refutes the possibility of deterministic quantum theories (Walleczek and Grössing, 2014) and (ii) introduced the distinction between ‘Shannon signals’ and ‘non-Shannon signals’ as part of a communication-theoretic analysis of the non-signalling theorem (Walleczek and Grössing, 2015). This latter distinction helps explain why the concept of nonlocal quantum information transfer need not be identified with superluminal signalling and communication.
The second part of the presentation compares the basic approaches – compatibilist and incompatibilist – towards the problem of free will in quantum mechanics and the non-signalling theorem. For the incompatibilist position, a frequent example is the “Free Will Theorem” by Conway and Kochen, and possible shortcomings of that proposal will be discussed. Another incompatibilist position is the well-known concept of “Super-deterministic Conspiracy”, which, like the “Free Will Theorem”, denies compatibility also between determinism and free will. For the compatibilist position, i.e., the view that free will can be compatible with determinism, the focus is on the – often misinterpreted – position of John S. Bell. Analysis of Bell’s position reveals that he sought a free will theorem capable of upholding the crucial distinction between determinism and pre-determinism, i.e., “effective” free will (Bell, 1977). That distinction refers to the concept of “determinism without pre-determinism”, in which the setting of a new boundary condition by an experimenter agent transforms an ‘indefinite ontic structure’ (IOS) into a ‘definite ontic structure’ (DOS).
In summary, two routes towards evading pre-determination of events can be identified. One route is fundamental (axiomatic) indeterminism (e.g., in orthodox quantum mechanics); the

other route is operational (effective) IOS-DOS transitioning (e.g., in de Broglie-Bohm theory). Importantly, neither route is found to address the problem of the “free-willed control” – by an agent – of any physical events in nature. Therefore, either route – effective or axiomatic – may satisfy the requirement of unpredictability, i.e., lack of pre-determination, of an agent’s choices based upon past information about the universe. In conclusion, “effective”, not only “axiomatic”, free will may be entirely sufficient to evade the danger of cosmic pre-determination.

References

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