Born's Rule as an Empirical Addition to Probabilistic Coherence

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Abstract. With the help of a certain mathematical structure in quantum information theory, there is a particularly elegant way to rewrite the quantum mechanical Born rule as an expression purely in terms of probabilities.

In this way, one can in principle get rid of complex Hilbert spaces and operators as fundamental entities in the theory. In the place of a quantum state, the new expression uses a probability distribution, and in the place of measurement operators, it uses conditional distributions.

The Born rule thus becomes a story of probabilities going in and probabilities coming out. Going a step further: In the Bayesian spirit of giving equal status to all probabilities – in this case, the ones on both the right and left sides of the Born-rule equation – it indicates that the Born rule should be viewed as a normative condition on probabilities above and beyond Dutch-book coherence.

In opposition to Dutch book coherence, this new normative rule is empirical, rather than purely logical in its origin (and by way of that must encode some of the physical content of quantum theory), but there may be other non-quantum situations that warrant the same or a similar addition to Dutch-book coherence: I make no judgment one way or the other, but I hope that this way of rewriting quantum theory may provide a suggestive new language for some of the non-quantum topics of this meeting.