Two Observers of Schrödinger's Cat

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During a colloquium at Princeton U. on Feb. 28, 2019, A.J. Leggett reiterated a view he had previously stated on p. R422 of [1]: *I believe a typical advocate of this kind of interpretation, if asked whether a particular electron in a Young's-slits experiment definitely goes through one slit or the other, would reply that it does not, and thereby implicitly agree that the question has a meaning; while the same advocate, if asked whether in Schrödinger's thought-experiment each individual cat is definitely alive or dead before any observation is made, would reply that she is.*

Here, we elaborate on an issue implicit in Schrödinger's "cat" experiment (p. 812 of [2]), but seldom discussed.[1,2] Schrödinger considered a cat in a *Stahlkammer*, which we will simply call a *box*, and associated it with a ψ-function that was a superposition of the cat being alive or dead. It would seem that this ψ-function would apply only to observers outside the box, in that an observer inside the box could, after observing the cat, say that the cat is alive, or dead, rather than a superposition of both.

However, Schrödinger's view is often interpreted (as by Leggett) to be that there is a single ψ-function, independent of observers.

Whereas, it seems clear (to the present author) that, in general, observers inside and outside the box associate different ψ-functions with the cat.

This conclusion could be dramatized by supposing that the (small) box actually encloses the first observer, while the cat and the second observer are (thinking) outside the box in the rest of the (large) Universe. Then, it should not be surprising that the restricted knowledge of the first observer leads him/her to associate a much different ψ-function with the cat than does the second observer, who can interact with (observe/measure) the cat.

While an awareness that the ψ-function of quantum theory is observer dependent does not eliminate the "weirdness" of that theory, the notion of "quantum weirdness" is also observer dependent.

References

[1] A.J. Leggett, *Testing the limits of quantum mechanics: motivation, state of play, prospects*, J. Phys. Cond. Mat. **14**, R415 (2002),
http://kirkmcd.princeton.edu/examples/QM/leggett_jpcm_14_r415_02.pdf

[2] E. Schrödinger, *Die gegenwärtige Situation in der Quantenmechanik*, Naturw. **23**, 807, 823, 844 (1935), http://kirkmcd.princeton.edu/examples/QM/schroedinger_naturw_23_807_35.pdf
Translation by J.D. Trimmer: *The Present Situation in Quantum Mechanics*, Proc. Am.

[1] The theme of this note seems to be in the spirit of so-called *quantum Bayesianism* (QBism) [3].

[2] Sept. 15, 2020. An intricate elaboration of this theme has recently appeared in [5].
July 9, 2022. See also [4].

Phil. Soc. **124**, 323 (1980),
http://kirkmcd.princeton.edu/examples/QM/schroedinger_naturw_23_807_35_english.pdf

[3] C.A. Fuchs and R. Schack, *Quantum-Bayesian coherence*, Rev. Mod. Phys. **85**, 1693 (2013), http://kirkmcd.princeton.edu/examples/QM/fuchs_rmp_85_1693_13.pdf

[4] N. David Mermin, *There is no quantum measurement problem*, Phys. Today **75**(6), 62 (2022), http://kirkmcd.princeton.edu/examples/QM/mermin_pt_75-6_62_22.pdf

[5] K.-W. Bong *et al.*, *A strong no-go theorem on the Wigner's friend paradox*, Nature Phys. (2020), http://kirkmcd.princeton.edu/examples/QM/bong_np_20.pdf