A Pragmatist View of Quantum States and Born Probabilities

From a pragmatist viewpoint, a quantum state is not descriptive. It describes neither a quantum system/ensemble nor knowledge of a quantum system/ensemble. Quantum theory is like an oracle: the quantum state is a source of authoritative advice to an agent on what to expect and so how to act in a given situation.

1. Typically, an agent's quantum state advises him/her/it to expect any of a set of possibilities. (Epistemic indeterminism.)
2. The quantum state extends the agent a limited license to act on the basis of whichever of these accords with his/her/its subsequent observations. (This is where decoherence comes in.)
3. For each possibility, the quantum state advises the agent with what degree of confidence to expect it, in accordance with the Born rule.
4. The quantum state is not unique: When consulting the oracle, the Born rule will offer agents in different physical situations different advice concerning the same system if the quantum states for their situations differ.

I. Introductory remarks: Would Bohr think our topic is not worth discussing? ("Quote" his reported remarks, and explain my changed attitude toward them). Quote Wheeler in red.

II. Write up Born Rule: $\text{prob}_\rho(A\varepsilon\Delta)=\text{Tr}(\rho\mathbf{P}^A[\Delta])$ (ρ, $\mathbf{A}$ self-adjoint operators on H_s)

Q1. What, exactly, is this a probability *of*?
A1. A NQMC: $A\varepsilon\Delta$ states that the value of A lies in Δ. There is no explicit or implicit reference to measurement, *but* QT licenses the claim only in the appropriate context.

Example 1: Fullerene interference experiments and the role of decoherence in quantum licensing (Quote Feynman on what one can't say in an interference experiment, and qualify this)

Q2. What is the nature of the quantum state?
A2. An authoritative guide to a physically situated agent's expectations.

Example 2: Application of QT to 45° polarized heralded photon incident on an H/V polarizing beam splitter with detector only in V channel.
i) Born rule applied to $1/\sqrt{2}\,(|H\rangle+|V\rangle)$: ii) status of "projection" $1/\sqrt{2}\,(|H\rangle+|V\rangle)\rightarrow|H\rangle$

Q3. How does an agent's quantum state relate to his/her/its physical situation?
A3. In several ways: temporally, as in E2; also spatio-temporally, as in this next example,

Example 3: Alice's and Bob's quantum states for single photons in EPR-Bell scenario, stressing rejection of eigenstate-eigenvalue link.

Q4. What kind of probabilities does the Born rule supply? Subjective/objective? A measure of absolute chance (potentiality), or only of ignorance?
A4. An objective measure of *physically inevitable* agent-relative ignorance.

Example 4: Entanglement-swapping in delayed choice/spacelike choice experimental scenario
Review abstract in the light of what I have said.