# Appendix B — Objections and Structural Responses

*Phase-2 canonical rewrite*

Purpose. This appendix is not marketing. It lists the highest-value failure modes of BCT and gives responses that are scope-honest, operational, and aligned with the Phase-2 canonical notation fixed in the BCT Glossary: integration window tau, record persistence tau_p, record loss timescale tau_loss, minimal persistence threshold tau*, conservative information threshold I_c, accessible algebra AA(tau), and agent-relative equivalence classes [Psi]_A.

Ground rule. BCT does not modify unitary dynamics. Its claims are: (a) a disciplined ontology of experienced state as an agent-relative equivalence class of global states, and (b) an operational bridge between definiteness and stable records.

## A. What is being claimed (and what is not)

### A1. "This is just philosophy: no new physics, no content."

Objection. If BCT does not change Schrodinger dynamics, then it adds nothing beyond decoherence / Quantum Darwinism and becomes unfalsifiable semantics.

Response. Two separate claims exist. First, an ontological claim: an experienced state is an agent-relative equivalence class of global states indistinguishable under the agent's physically accessible algebra AA(tau) within a finite integration window tau, together with stable-record constraints. Second, an operational bridge: a macroscopic interaction counts as event-like for agent A only when the relevant distinction is carried by a record that is accessible, stable, and persistent beyond the calibrated threshold tau*. Even if the underlying dynamics remain unitary, the bridge yields concrete defeat conditions. If one engineers I_c >= 1 effective bit and tau_p >= tau* yet can still sustain or recover interference for the same agent under the same operational regime, the bridge fails. Conversely, if event-like definiteness is obtained without the bridge conditions, the bridge fails.

### A2. "You are smuggling consciousness into physics."

Objection. The word "experience" sounds like a hidden causal agent. Are you saying consciousness collapses the wavefunction?

Response. No. BCT does not claim mental causation. It defines an experienced state as an equivalence-class label tied to physically accessible observables and stable records. "Collapse" is then the agent-relative update of [Psi]_A when a stable record-bit becomes fixed. The physics stays unitary; the update is about which equivalence class the agent occupies, not about an extra dynamical push.

### A3. "This is Many-Worlds with different words."

Objection. Equivalence classes plus branching sounds like MWI with a linguistic patch.

Response. BCT is compatible with a unitary global ontology, but it does not inherit MWI's standard subject-selection gap. It does not infer "many subjects" from microphysical multiplicity alone. For BCT, many micro-alternatives can remain compatible with one experienced label [Psi]_A as long as the agent's accessible stable record-structure has not split. The proposal is not anti-unitary; it is anti-overcounting at the level of agent-relative definiteness.

## B. Definitions and circularity

### B1. "Agent A is vague. What counts as an agent?"

Objection. Without a sharp criterion, "agent-relative" collapses into arbitrariness. Does a camera count? A rock? A thermostat?

Response. BCT uses an operational criterion. An agent is a physical system with (i) a limited physically accessible algebra AA(tau) and (ii) finite integration over a window tau. This excludes "anything whatsoever" by design. If a system cannot stably integrate and reuse records within its constraints, it does not instantiate the BCT notion of experienced definiteness. Borderline cases are treated as parameter-dependent questions about access, integration, and record stability, not as occasions for metaphysical handwaving.

### B2. "Circularity: records define experience, but experience defines records."

Objection. If records matter because an experience reads them, you are defining collapse by assuming collapse.

Response. BCT does not define recordhood semantically. A record is defined physically by accessibility, robustness, redundancy, and persistence. A record variable R counts only if it can be read through AA(tau), remains stable under the declared perturbation tolerances, and persists with tau_p above the threshold tau*. Experience is then the equivalence-class label constrained by AA(tau) plus those stable records. No semantic "reading" is required; only physical accessibility and persistence.

### B3. "Information is semantic, not physical."

Objection. Saying "one bit" sounds like meaning or interpretation. In quantum mechanics there are amplitudes, not 'bits'.

Response. In BCT, information is operational: how many outcome-distinguishing degrees of freedom are available in a record channel under physically realizable measurements and finite resources. The threshold I_c >= 1 means that there exists at least one effective binary distinction in the record substrate that is stably instantiated and physically accessible within the frozen regime. This is compatible with standard quantum information language: "bits" are coarse-grained distinctions defined by realizable projectors or POVM-style readouts on record-stable macro-conditions.

### B4. "Equivalence classes hide the microphysics and become unfalsifiable."

Objection. If anything can be stuffed into an equivalence class, the theory cannot be wrong.

Response. Equivalence classes are constrained, not elastic. They are fixed by the agent's physically accessible algebra AA(tau), by the finite integration window tau, and by explicit record-stability thresholds such as tau_p >= tau* together with redundancy and robustness criteria. Those same constraints generate the falsification targets: one can vary access, vary retention, and test whether event-like definiteness tracks those variables as claimed.

## C. Consistency with standard quantum mechanics

### C1. "Wigner's friend: you still get contradictions."

Objection. If the Friend has a definite outcome and Wigner treats the lab as superposed, who is right?

Response. Both may be right relative to their own operational interfaces. The Friend's experienced label is defined by stable internal records accessible through the Friend's AA(tau). Wigner's accessible algebra may not yet include any stable record of the internal pointer value. In that case the Friend's record is stable-for-Friend but not yet stable-for-Wigner, so the two agents induce different equivalence relations without

contradiction. BCT rejects the demand for a single omniscient experienced label that must be simultaneously valid for all agents at all stages.

### C2. "Preferred basis problem: what picks the projectors?"

Objection. If outcomes are record-stable macro-conditions, which basis is that? Is it not arbitrary?

Response. The record basis is selected operationally by stability. Pointer-like states are precisely those that remain robust under the relevant loss channels long enough to count as stable records and, where appropriate, become redundantly imprinted in accessible degrees of freedom. This aligns BCT with decoherence and pointer-state logic, but BCT adds an ontology of definiteness on top of that stability story. Where stability is weak or basis competition remains unresolved, BCT predicts weaker or delayed event-like definiteness rather than pretending a sharp record basis already exists.

### C3. "Relativity: what about ordering and simultaneity?"

Objection. If collapse is an 'update', does it imply a preferred time slicing?

Response. No physical collapse hypersurface is introduced. The global state may remain unitary throughout. "Update" refers only to the agent-relative change of [Psi]_A once a stable record becomes available for that agent. The relevant times tau, tau_p, tau_loss, and tau* are local operational timescales, not a new universal slicing.

### C4. "No-signalling: can I exploit accessibility to send FTL?"

Objection. If definiteness depends on access, can I control access to influence distant outcomes?

Response. No. Accessibility and record persistence are local physical constraints. Changing AA(tau) or record retention on one side cannot transmit controllable information faster than light because the global dynamics and marginal statistics remain standard. BCT alters the ontology of definiteness, not the no-signalling structure of quantum mechanics.

### C5. "Quantum eraser already explains record accessibility."

Objection. Your inaccessible-record scenarios are just quantum erasers; nothing new.

Response. BCT agrees that eraser-type reversibility exists in standard quantum mechanics. Its contribution is not a new interference formula, but a disciplined criterion for when an event-like record exists for a given agent. In eraser regimes the relevant record channel fails accessibility or persistence conditions, so BCT says that event-like definiteness-for-A should not be asserted prematurely. The gain is conceptual discipline, not a rival dynamical formalism.

## D. Probability and Born form

### D1. "Born-rule arguments depend on controversial assumptions."

Objection. Gleason-style uniqueness uses non-contextuality and additivity. Why should an agent accept those assumptions?

Response. The Phase-2 claim is conditional and explicit. Once outcomes are represented by record-stable macro-conditions and once support assignments obey standard operational consistency constraints — normalization, additivity on orthogonal record projectors, non-contextuality for a fixed record condition, and unitarity covariance — the Born form is uniquely selected by Gleason-style reasoning. BCT does not pretend these assumptions are metaphysical axioms of the universe. It claims they are the natural consistency conditions for a support measure over record-defined outcome classes.

### D2. "Dimension-2 loophole: Gleason does not apply."

Objection. For bare qubits, standard Gleason has exceptions; your uniqueness claim may fail.

Response. BCT anchors the argument to record-stable macro-conditions in the enlarged Hilbert space of system plus apparatus plus environment. Even when the measured subsystem is two-dimensional, the relevant record projectors live at the apparatus / environment level, where dimension >= 3 is generic. The uniqueness claim is therefore about record-defined outcome classes, not about isolated qubit projectors in abstraction.

### D3. "Frequency vs probability: you are redefining probability."

Objection. Saying 'probability is frequency' is philosophically loaded.

Response. BCT does not need a crude identification of probability with frequency. It uses frequency as an empirical anchor: the support measure over record-defined outcome classes must match long-run relative frequencies under repeated preparations, within the operational constraints already stated. Subjective or Bayesian expectation can still be modeled, but it must be calibrated to that same support structure.

## E. Parameters, anthropocentrism, and falsifiability

### E1. "tau* is anthropocentric."

Objection. If you import human-like timescales, the theory becomes biology-specific and unscientific.

Response. BCT treats tau* as an operational threshold, not as a universal metaphysical constant. Human timescales may motivate one substrate class, but other agents or controllers can have very different thresholds. What matters in Phase 2 is the role of a minimal persistence threshold in defining event-like recordhood, not one universal numerical value.

### E2. "The bridge postulates look hand-picked."

Objection. Why exactly I_c >= 1 and tau_p >= tau*? Why not some smooth function instead?

Response. Phase 2 chooses conservative, testable criteria on purpose. At least one effective record-bit is the minimal non-trivial discriminant of alternative outcome classes, and persistence beyond threshold distinguishes event-like records from ephemeral correlations. A more continuous formulation may be developed later, but credibility is improved by first stating a clean falsifiable core.

### E3. "Your falsification proposals cannot isolate experience."

Objection. Experiments measure interference and records, not subjective states. So what exactly is being falsified?

Response. The falsified object is the operational bridge, not unitary quantum mechanics itself. BCT predicts when it is legitimate to assert event-like definiteness-for-an-agent in terms of record accessibility and persistence. If one can systematically violate that bridge — for example by obtaining stable event-like records without the criterion, or by meeting the criterion without event-like transition organization — then the BCT bridge fails.

### E4. "Inaccessible or encrypted records are ill-defined physically."

Objection. 'Encrypted' is semantic; physics does not care about meaning.

Response. Agreed. In Phase 2, inaccessibility must be defined strictly physically: no physically realizable measurement within the agent's AA(tau) can extract the relevant record-bit within tau under finite resources. If a scenario reduces to "the information is there but nobody bothered to look," it is not a BCT test. Only genuine physical inaccessibility counts.

### E5. "Does BCT imply panpsychism or an explosion of experiences?"

Objection. If any system has some AA(tau) and some tau, do electrons have experiences?

Response. BCT avoids automatic panpsychism by requiring agent-level structure: a non-trivial accessible algebra together with integration and record stability sufficient to sustain re-identifiable record structure over time. Systems lacking stable memory-like organization do not automatically qualify. Borderline cases remain empirical and architectural questions, not slogans.

### E6. "If the record later degrades, does the collapse undo itself?"

Objection. If tau_p later falls below threshold, does the event unhappen?

Response. No. The criterion concerns when an event-like record becomes fixed relative to an agent, namely when a stable record-bit exists with tau_p above threshold and updates [Psi]_A. Later degradation changes later accessible records and therefore later equivalence classes, but it does not retroactively erase the earlier update.

### E7. "Occam's razor: you added axioms."

Objection. MWI keeps only unitarity; you add identity and record postulates.

Response. Occam counts explanatory work per postulate, not just raw quantity. MWI removes collapse but leaves the subject-selection problem largely implicit. BCT pays an explicit price by adding minimal identity and record constraints so that "definiteness-for-A" becomes non-elastic and operationally anchored. If one wants an interpretation that speaks about experience at all, the price is at least visible and test-linked.

## F. Hard objections kept in scope

### F1. "Your framework is compatible with too many global ontologies."

Objection. If BCT can coexist with several global metaphysical pictures, it may be underdetermined.

Response. Yes, Phase 2 is deliberately tolerant at the global-ontology level. Its aim is not to settle everything at once, but to pin down the ontology of experienced definiteness and the operational bridge to stable records. BCT is therefore best read as a constrained layer: it specifies what must be true about records, access, and persistence for experience claims to be meaningful, even if more than one global picture remains compatible.

### F2. "You may be redefining collapse into existence."

Objection. If collapse is just a change of equivalence class, you have not solved measurement — you have renamed it.

Response. If one demands a non-unitary physical mechanism, then BCT is indeed not that type of proposal. But that is a difference of research program, not a refutation. BCT's target is the measurement problem as a problem of definiteness-for-experience. It claims the hard part is not merely adding a term to Schrodinger dynamics, but making "definite outcome" a non-elastic concept tied to stable records and finite access.

Editorial note. This appendix is intentionally written to survive hostile but competent questioning. If an objection cannot be answered without handwaving, it should be marked as an open problem rather than patched with rhetoric.