It Was in This Box Before You Opened It: A Paradox Re-Examined

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[AWARD: Best Contributed Paper — physical demonstration of thesis was judged outstanding by committee]

Abstract. We re-examine the classical *Box Paradox*: the observation that a cat is reliably found inside any sufficiently large cardboard box, despite no one having observed the cat enter. We argue that the paradox is not a paradox at all, but a consequence of *Box-State Inversion*: the cat was in the box before the box was opened; observation does not reveal this state but rather, in the quantum-mechanical sense, constructs it retroactively. We introduce the *Cat-Box Wavefunction* $\mathcal{CB}$, prove the *Box Inevitability Theorem*, and report experimental confirmation across 94 boxes of varying geometry. Dr. Biscuit Pawsworth III independently confirmed all results in a parallel series of trials he undertook without being asked, because the boxes were there.

Keywords: box mechanics, cardboard, retroactive occupation, box-state inversion, cat-box wavefunction, inevitable entry

1. Introduction

Place a cardboard box on the floor of any room occupied by a cat. Leave the room. Return. The cat will be in the box. This is not a conjecture; it is a fact so well-attested as to require no citation (though we provide several anyway [1, 2]). The phenomenon is robust across box sizes, box origins (Amazon, USPS, artisanal), box conditions (open, collapsed, partially assembled), and feline temperament.

What *is* paradoxical is this: no one sees the cat get in. In our 94 experimental trials, not a single box-entry event was directly observed. The graduate student placed the box, looked away, and the cat was in it. Dr. Biscuit Pawsworth III, a naturally curious individual, attempted to observe his own box-entry in a reflective surface and reported only that he "was suddenly in the box and the whole thing is fine."

The classical explanation — that the cat simply waited for an unobserved moment — is inadequate. It implies that cats actively coordinate their behaviour with human attention states, which, while plausible, is insufficiently weird to be published in these proceedings.

We propose instead a quantum-mechanical account: the cat–box system exists in a superposition of $|\text{in-box}\rangle$ and $|\overline{\text{box}}\rangle$ states, and observation collapses it to $|\text{in-box}\rangle$ with probability approaching unity.

2. Theoretical Framework

2.1. Box Axioms

Axiom 1 (First Axiom of Box Mechanics)**.** *Any box of interior volume $V \geq V_{\min}$ is a potential cat-occupation site, where $V_{\min}$ is defined as the volume of the smallest space the cat can physically occupy, less 10%.*

Axiom 2 (Second Axiom of Box Mechanics)**.** *The cat–box interaction potential $U(r)$ is strongly attractive for cat–box separations $r < R_{\text{room}}$ (one room radius) and effectively zero outside. There is no repulsive core.*

2.2. The Cat-Box Wavefunction

Let $\mathcal{CB}(t)$ denote the state of the cat–box composite system:

$$\mathcal{CB}(t) = \alpha(t)\ |\text{in-box}\rangle + \beta(t)\ \left|\overline{\text{box}}\right\rangle, \quad |\alpha|^2 + |\beta|^2 = 1. \tag{1}$$

The coefficient $\alpha(t)$ evolves under the cat–box Hamiltonian:

$$\hat{H}_{\mathcal{CB}} = E_{\text{box}}\ |\text{in-box}\rangle\langle\text{in-box}| + E_{\text{out}}\ \left|\overline{\text{box}}\right\rangle\left\langle\overline{\text{box}}\right| - \Delta_{\text{box}}\left(|\text{in-box}\rangle\left\langle\overline{\text{box}}\right| + \right. \tag{2}$$

where $E_{\text{box}} < E_{\text{out}}$ (box is the ground state; this is axiomatic) and Δ_{box} is the box-entry tunnelling amplitude. Time-dependent perturbation theory shows that $|\alpha(t)|^2$ approaches 1 on a timescale $\tau_{\text{box}} \sim \hbar/\Delta_{\text{box}}$, which empirically is "however long you weren't watching."

2.3. Box-State Inversion

Theorem 1 (Box Inevitability Theorem)**.** *For any box satisfying Axiom 1, the probability that the cat–box wavefunction collapses to $|\text{in-box}\rangle$ upon the first observation approaches:*

$$p(|\text{in-box}\rangle) \to 1 - e^{-\lambda_{\text{box}} V}, \tag{3}$$

where $\lambda_{\text{box}} = (2.3 \pm 0.2)\,\text{L}^{-1}$.

Corollary 2. *For $V \geq 30\,L$ (a standard shipping box), $p(|\text{in-box}\rangle) > 0.999$. The cat will be in the box.*

Equation (3) predicts that even a very small box ($V \sim 5\,\text{L}$) has $p(|\text{in-box}\rangle) \approx 0.69$. Field observation confirms this: cats will attempt boxes they cannot physically fit in, collapsing the wavefunction to a configuration that is, technically, in the box (two paws and a face count).

3. Experimental Results

3.1. Box Sample

Ninety-four boxes were sourced from: Physics Department mail room ($n = 31$), departmental Amazon deliveries ($n = 28$), personal online shopping of graduate students ($n = 19$, contents irrelevant), and boxes of unknown origin that appeared in the hallway ($n = 16$; provenance never established; possibly from the void, per Dr. Shadow McVoidface, who was not formally a co-author on this paper but submitted an opinion anyway).

Box volumes ranged from 2.1 L (too small; attempted anyway) to 87.4 L (very large; lead author and Biscuit both in it simultaneously; exceptional case).

3.2. Occupation Results

Table 1: Box occupation outcomes by volume ($n = 94$).

Volume (L)	n	$p(\lvert\text{in-box}\rangle)$ obs.	$p(\lvert\text{in-box}\rangle)$ pred.
2–5	11	0.73 ± 0.13	0.69–0.97
5–15	18	0.94 ± 0.06	0.97–1.00
15–30	22	0.98 ± 0.03	1.00
30–60	29	1.00 ± 0.00	1.00
> 60	14	1.00 ± 0.00	1.00

Agreement between Eq. (3) and observation is excellent across all size categories. The "two paws and a face" configuration was observed 7 times in the < 5 L category and is counted as $\lvert\text{in-box}\rangle$ per our operational definition (Section 3.3).

3.3. The Simultaneous Occupation Event

Trial 87 produced the extraordinary result of both the lead author *and* Dr. Biscuit Pawsworth III occupying the same 87.4 L box simultaneously. Both subjects deny entering after the other. The wavefunction formalism permits this: the box state $\lvert\text{in-box}\rangle \otimes \lvert\text{in-box}\rangle$ is not forbidden by any axiom stated above, and Eq. (3) says nothing about exclusivity. We treat this as a discovery rather than a problem.

3.4. The Freshly Assembled Box Effect

A surprising finding: boxes that were assembled from flat within view of the cat showed a mean time-to-occupation of $\tau = 14 \pm 3$ s — substantially faster than boxes placed pre-assembled ($\tau = 47 \pm 12$ s). We attribute this to the cat *observing the construction* of the box state and exhibiting an anticipatory collapse that precedes the formal measurement event. This is either a violation of causality or exactly what quantum mechanics predicts; the authors disagree and have agreed to disagree.

4. Conclusion

The Box Paradox is resolved: it is not a paradox, but a consequence of the $\lvert\text{in-box}\rangle$ ground state being energetically favoured, the box-entry tunnelling amplitude being large whenever no one is looking, and the Box Inevitability Theorem ensuring $p \to 1$ for any box of reasonable size.

The paper was delivered as a poster at the 3rd International Cardboard Symposium. The lead author remained in the conference-provided box for the duration of the poster session. This was described by the award committee as "a compelling physical demonstration of the thesis."

Contributions

Cheeto: theory, experimental participation (all trials), award acceptance (from inside box). Biscuit: parallel independent trials (unsolicited but welcome), simultaneous occupation event, Axiom 2 derivation.

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References

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[3] E. Schrödinger, *Naturwissenschaften* **23**, 807 (1935). [See also Cheeto (1996) for a more thorough experimental treatment.]

[4] Cheeto et al., *Quantum Cat Physics Review* **5**(1), 1 (1996).

[5] B. Pawsworth III, "Personal field notes on spontaneous box entry," unpubl. (1995). ["I was just suddenly in it. This is fine. The box is good."]