Fun vs. Black Hole: An Accretion Model in Unified Probability Theory

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Abstract

We present a three-state toy system in Unified Probability Theory (UPT) that models the felt dynamics of sharing creative work (*fun*) in the presence of an academic gatekeeper (a *black hole*). The model uses UPT's conservative mechanics on the probability simplex—potential, emergence (viability), resonance, and a threshold-gated cascade—to formalize "accretion" of probability mass from playful exploration into reductionist collapse. The goal is explanatory: to show, as a small but rigorous example, how UPT encodes the transition from healthy engagement to accretion once criticality is crossed.

1 State, events, and intuition

Let $\mathcal{A} = \{F, O, B\}$ denote disjoint events (fun, engagement orbit, black hole). The time-dependent distribution $\mathbf{P}(t) = (P_F(t), P_O(t), P_B(t))$ lives on the probability simplex $\Delta^2 = \{\mathbf{p} \in \mathbb{R}^3 : \ p_k \geq 0, \ \sum_k p_k = 1\}$. Intuitively: F radiates playful exploration; O is the back-and-forth where the outcome can still go either way; B is the reductionist sink.

2 UPT operators (conservative forms)

We re-use the UPT operators in a minimal three-node system. Let $\boldsymbol{z} = (z_F, z_O, z_B)$ be an anchor (baseline) distribution and $\phi_k > 0$ be potential strengths. Define the scalar potential

$$\mathcal{V}(\mathbf{P}) = \sum_{k \in \{F,O,B\}} \tfrac{1}{2}\, \phi_k\, (P_k - z_k)^2, \qquad g_k = \frac{\partial \mathcal{V}}{\partial P_k} = \phi_k\, (P_k - z_k). \tag{1}$$

To conserve total probability, use the zero-sum projection $\Pi(\mathbf{v}) = \mathbf{v} - \frac{1}{3}(\mathbf{1}^\top \mathbf{v})\mathbf{1}$ and take the potential term $-\Pi(\nabla \mathcal{V})$ (descent toward anchors).

Emergence (viability). With parameters $\beta_k \in \mathbb{R}$, $V_{\text{th}} \in \mathbb{R}$, $\sigma > 0$,

$$\Lambda_k(\mathbf{P}) = \beta_k\, \tanh\!\Big(\frac{V_k(\mathbf{P}) - V_{\text{th}}}{\sigma}\Big), \qquad V_k(\mathbf{P}) = \tfrac{1}{2}\, \phi_k\, (P_k - z_k)^2, \tag{2}$$

and recenter to zero-sum: $\widehat{\Lambda}_k = \Lambda_k - \frac{1}{3}\sum_i \Lambda_i$.

Resonance (pairwise conservative coupling). Let

$$S_{ij}(\mathbf{P}) = A_{\text{res}} \tanh\Big(\frac{\widehat{V}_{ij}(\mathbf{P}) - V_c}{\tau_{\text{res}}}\Big), \qquad \widehat{V}_{ij}(\mathbf{P}) = \tfrac{1}{2}\big(V_i(\mathbf{P}) + V_j(\mathbf{P})\big), \tag{3}$$

with $S_{ij} = S_{ji}$ and nonzero only for adjacent modes: $S_{FO} = S_{OF}$, $S_{OB} = S_{BO}$, $S_{FB} = 0$. Define resonance fluxes $r_{i\to j} = \gamma\, S_{ij}\, P_i$ and the net

$$R_k(\mathbf{P}) = \sum_{j\neq k} \big(r_{j\to k} - r_{k\to j}\big). \tag{4}$$

Then $\sum_k R_k \equiv 0$.

Cascade (accretion). Define the cascade potential

$$\Phi(\mathbf{P}) = \max\Big\{\, S_{FO}(\mathbf{P})\, E_{FO}(\mathbf{P}),\ S_{OB}(\mathbf{P})\, E_{OB}(\mathbf{P}) \,\Big\}, \qquad E_{ij}(\mathbf{P}) = \beta_{ij} \tanh\Big(\frac{\widehat{V}_{ij}(\mathbf{P}) - V_{\text{th}}}{\sigma}\Big). \tag{5}$$

When $\Phi \geq \Phi_{\text{critical}}$, cascade fluxes turn on as gated, antisymmetric reallocations:

$$W_{i\to j}(\mathbf{P}) = \mathbf{1}\{\Phi \geq \Phi_{\text{critical}}\}\, \frac{\big[S_{ij}(\mathbf{P})\, E_{ij}(\mathbf{P})\big]_+}{\sum_{\ell\neq i} \big[S_{i\ell}(\mathbf{P})\, E_{i\ell}(\mathbf{P})\big]_+ + \varepsilon}, \tag{6}$$

$$c_{i\to j}(\mathbf{P}) = W_{i\to j}(\mathbf{P})\, P_i, \qquad \mathcal{C}_k(\mathbf{P}) = \sum_{j\neq k} \big(c_{j\to k} - c_{k\to j}\big), \tag{7}$$

with $[x]_+ = \max(x, 0)$ and small $\varepsilon > 0$. Again $\sum_k \mathcal{C}_k \equiv 0$.

3 Unified dynamics and schedule

The UPT flow on Δ^2 is

$$\dot{\mathbf{P}} = -\,\Pi(\nabla\mathcal{V}) \;+\; \widehat{\Lambda}(\mathbf{P}) \;+\; R(\mathbf{P}) \;+\; \alpha(t)\, \mathcal{C}(\mathbf{P}), \tag{8}$$

with cascade schedule

$$\alpha(t) = \begin{cases} 0, & \Phi(\mathbf{P}(t)) < \Phi_{\text{critical}}, \\ \alpha_0\, 2^{\,n(t)}, & \Phi(\mathbf{P}(t)) \geq \Phi_{\text{critical}}, \end{cases} \qquad n(t) = \#\{s \leq t:\ \Phi(\mathbf{P}(s)) \text{ crossed } \Phi_{\text{critical}}\}. \tag{9}$$

4 Conservation, invariance, and horizon

Theorem 1 (Simplex invariance and conservation)**.** *For bounded parameters and $\varepsilon > 0$, the vector field is locally Lipschitz. For any $\mathbf{P}(0) \in \Delta^2$, the solution exists forward in time, remains in Δ^2, and satisfies $P_F + P_O + P_B \equiv 1$.*

Sketch. tanh is smooth; the rational gate is bounded by ε; Π enforces zero-sum for the potential; $\widehat{\Lambda}$, R, $\mathcal{C}$ are pairwise antisymmetric or recentered to zero-sum. Standard inward-pointing arguments at the faces of Δ^2 guarantee nonnegativity. □

Remark 1 (Event horizon and "accretion")**.** If $S_{OB}E_{OB}$ dominates while the gate is open, the cascade channel $O \to B$ captures mass rapidly; once P_F falls below a threshold P_F^{hor}, further recovery becomes unlikely absent an exogenous change (e.g. a respectful engager increasing $S_{FO}E_{FO}$). This is the *fun horizon.*

5 Minimal parameterization (one plausible choice)

For illustration (dimensionless units): $\boldsymbol{z} = (0.7, 0.25, 0.05)$, $\phi_F = \phi_O = \phi_B = 0.2$, $A_{\text{res}} = 1$, $V_c = 0.12$, $\tau_{\text{res}} = 0.08$, $\beta_F = +0.05$, $\beta_O = 0$, $\beta_B = -0.03$, $\beta_{FO} = +0.5$, $\beta_{OB} = +0.7$, $V_{\text{th}} = 0.02$, $\sigma = 0.04$, $\Phi_{\text{critical}} = 0.015$, $\gamma = 0.2$, $\alpha_0 = 0.6$, $\varepsilon = 10^{-6}$.

Plain-language summary (the "why this feels true" part)

Fun (F) radiates; the gatekeeper (B) pulls. At first, engagement (O) can resonate with fun. If that resonance is respectful, probability cycles between F and O and you keep creating. If the interaction turns reductionist, the pair (O, B) crosses a threshold and a *cascade* (accretion) switches on: mass flows along $F \to O \to B$ rapidly. Cross the horizon and P_F collapses toward zero—not because probabilities have "energy," but because the vector field on the simplex now points into the accretion channel.