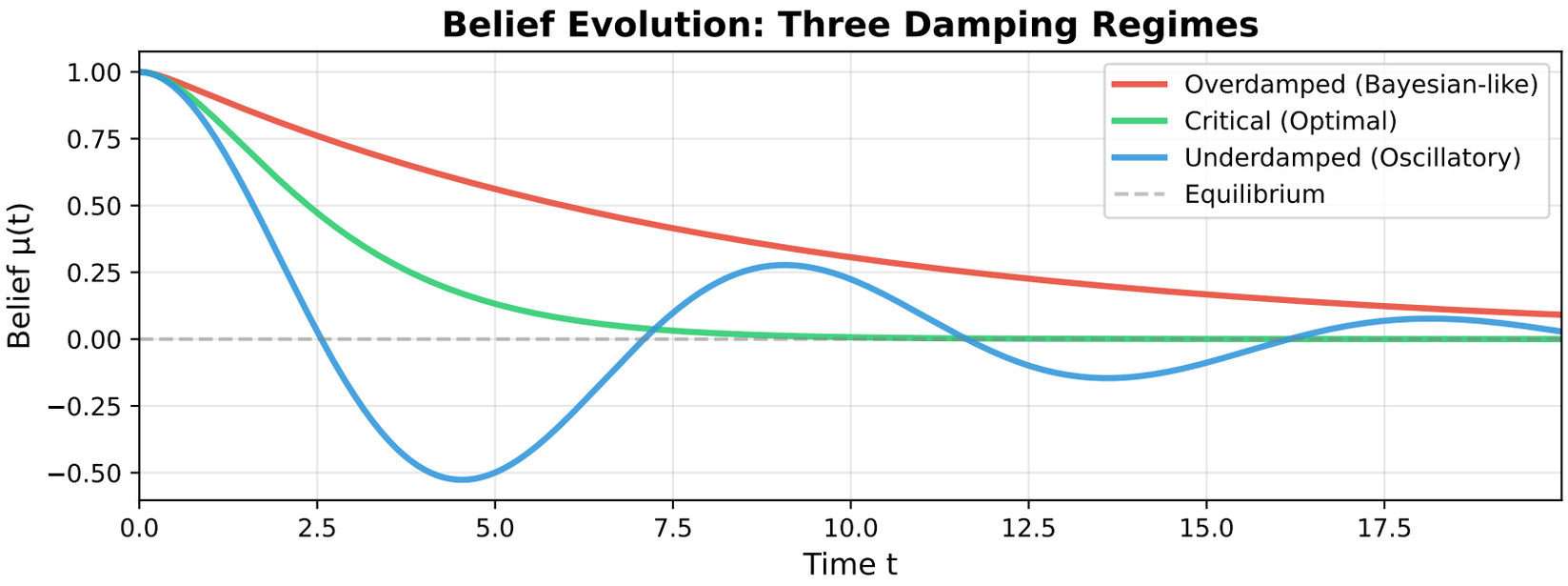
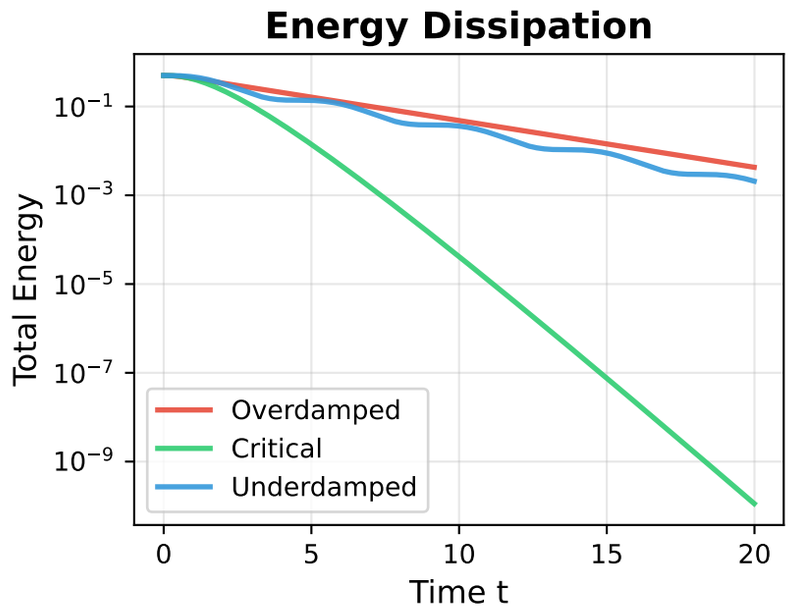
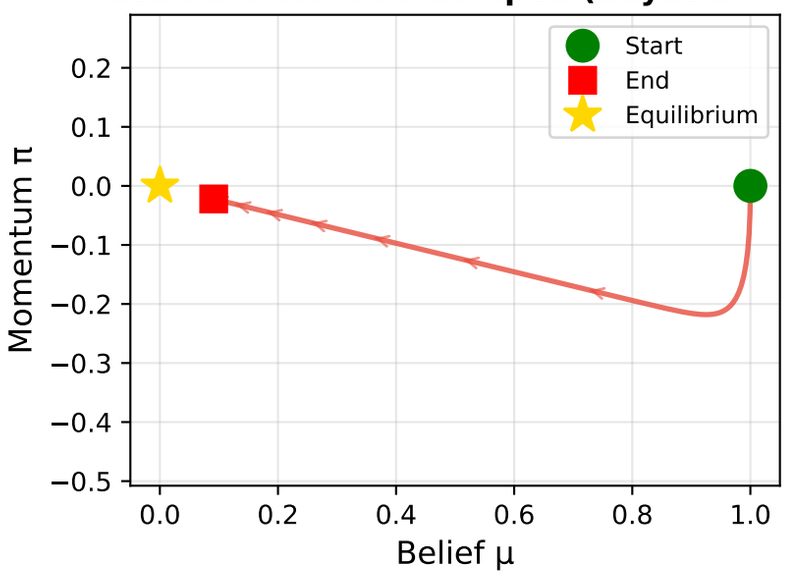
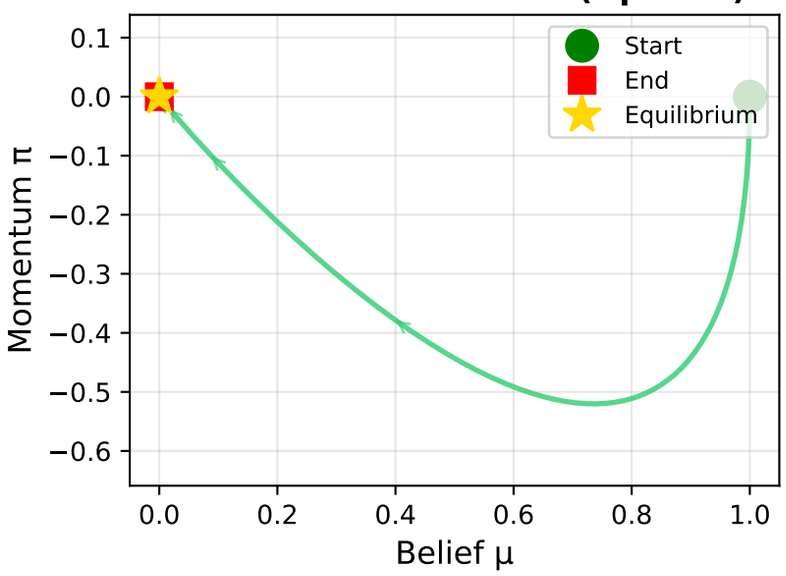
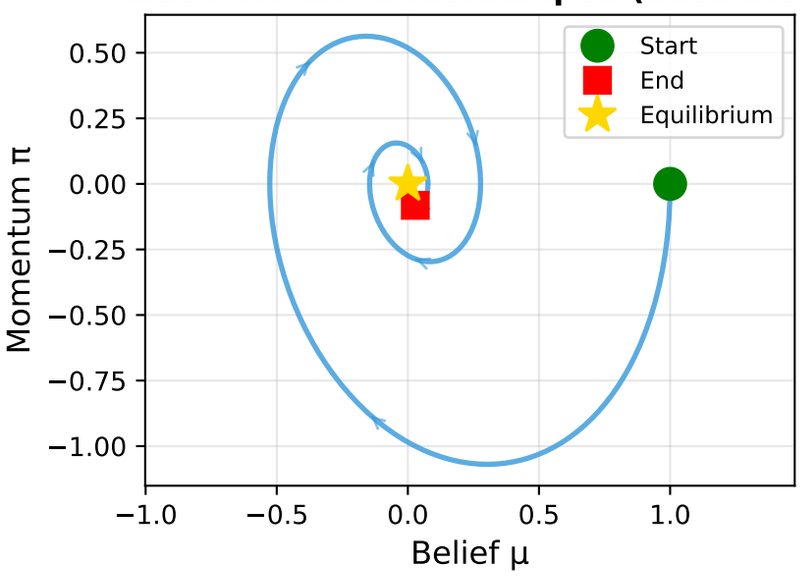
The Inertia of Belief: Damping Regimes in Epistemic Dynamics

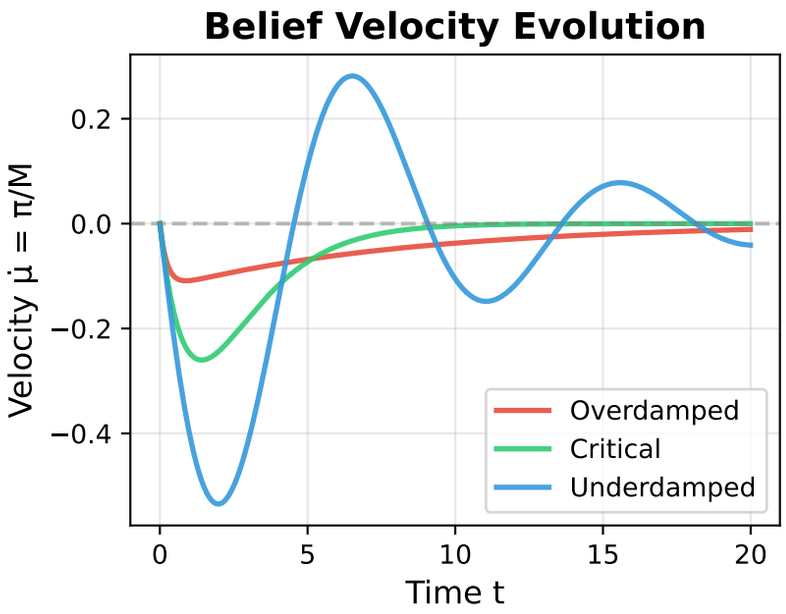


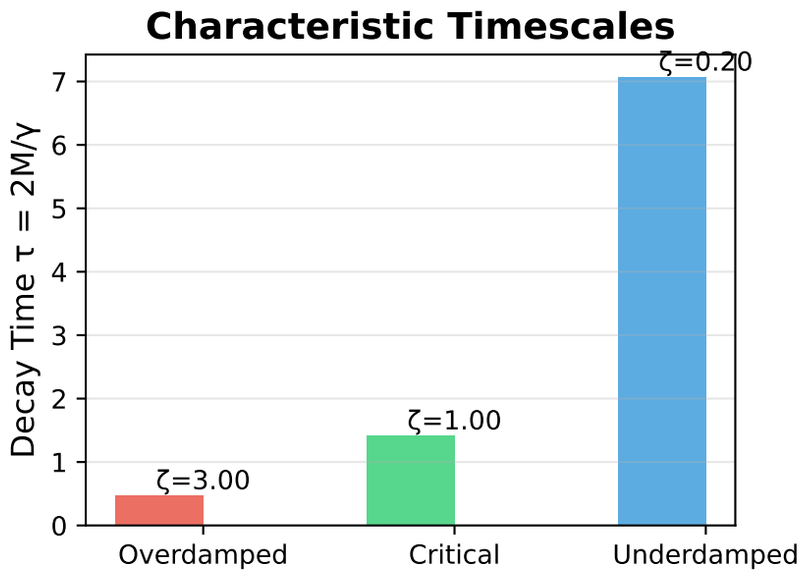












KEY PREDICTIONS FROM MANUSCRIPT:

Damped Oscillator Equation (Eq. 36):
$M\ddot{\mu} + \gamma\dot{\mu} + K\mu = 0$

Where $M = \Lambda$ (precision = mass)

Three Regimes (based on $\Delta = \gamma^2 - 4KM$):

- OVERDAMPED ($\Delta > 0$):
  Monotonic decay, no oscillation
  ≈ Standard Bayesian updating

- CRITICAL ($\Delta = 0$):
  Fastest approach to equilibrium
  $\gamma_c = 2\sqrt{KM}$ = optimal learning

- UNDERDAMPED ($\Delta < 0$):
  Oscillatory with overshooting
  Novel prediction: belief oscillation!

Frequency: $\omega = \sqrt{K/M - \gamma^2/4M^2}$
Decay time: $\tau = 2M/\gamma$