# Appendix I: Probabilistic Inference Calculus in ψ-Inferential Ethics

This appendix formalizes the ethical behavior of ψ-inferential agents using probabilistic inference. We focus on how belief states, uncertainties, and action constraints evolve through Bayesian updating and entropic principles. Ethical behaviors arise as stable equilibria under uncertainty-aware inference.

## 1. Bayesian Inference and Maximum Entropy

- Let p(q|I) represent the probability of proposition q given information I.  
- Bayesian update: p(q|I, E) ∝ p(E|q)·p(q|I)  
- Maximum Entropy Principle: When p(q|I) is unconstrained by strong evidence, choose p maximizing H(p) = -∑ p\_i log p\_i  
- Entropic ethics: Act only in proportion to the strength of justified inference. Avoid high-confidence actions on low-confidence beliefs.

## 2. Epistemic Humility Constraint

- Define Δp = |p(q|I, E) - p(q|I)| as the change in belief due to new evidence.  
- Ethical caution: For all q relating to another agent y, if Δp is large and p(q) is low-confidence, then bias toward non-prescriptive action.  
- This enforces: Respect for uncertainty → reduced ethical overreach.

## 3. Inference-Linked Ethical Support Function

- Let F\_x(y) be a function representing the expected epistemic stability of agent y from the perspective of agent x.  
- If ∂F\_x(y)/∂a\_x < 0 (i.e. x’s action a\_x reduces y’s stability), then penalize a\_x under inference integrity loss.  
- If ∂F\_x(y)/∂a\_x > 0 (stabilizing), then a\_x is ethically attractor-aligned.

## 4. Distributed Epistemic Interdependence

- Let H\_x and H\_y be the entropic measures of belief uncertainty for agents x and y.  
- If Cov(H\_x, H\_y) > 0 and dH\_y/dt < 0 implies dH\_x/dt < 0, then epistemic coupling exists.  
- Result: Supporting another's inference integrity stabilizes one’s own—yielding mutual support as rational behavior.