

# Focus-Based Decision Theory under Uncertainty

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## Abstract

This paper develops a focus-based decision-theoretic framework for choice under heterogeneous uncertainty, without requiring probability-based evaluation across all domains. Rather than evaluating acts through probability-weighted averages, evaluation is organized around *focus states*—salient contingencies that jointly reflect plausibility and consequence—capturing environments in which attention concentrates on a small number of decisive scenarios rather than aggregating over the entire state space.

The analysis distinguishes three uncertainty domains: roulette risk ( $R$ ), horse-race uncertainty ( $H$ ), and ignorance ( $I$ ). These domains are evaluated within a sequential representation that reflects an epistemic ordering of uncertainty resolution rather than intertemporal choice. Within this structure, anchoring and asymmetric evaluation across domains arise as structural consequences of preference consistency, rather than as behavioral assumptions. In particular, cardinal possibility weights (a non-probabilistic weighting of states) over the horse-race domain are derived from preference comparisons under minimal axioms, and the  $\tau$ -*anchor* emerges as a structural reference point governing cross-domain evaluation, with cross-domain order reversals being structurally constrained rather than postulated as fully reversible.

Building on the cardinal representation results of Giang (2015, 2016), the framework reorganizes the axiomatic environment so that anchoring and a restricted form of H–R reversibility are transparent and minimal, while broader reversal patterns emerge endogenously within the representation. Overall, the paper provides a parsimonious foundation for analyzing anchoring, asymmetry, and partial reversibility in decision making under heterogeneous uncertainty beyond purely probabilistic risk.

**Keywords:** Focus-based decision theory, Non-probabilistic uncertainty, Anchoring, Heterogeneous uncertainty, Preference consistency  
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